

FLORISTIC AND BIOSYSTEMATIC  
INVESTIGATIONS IN  
PLANT TAXONOMY

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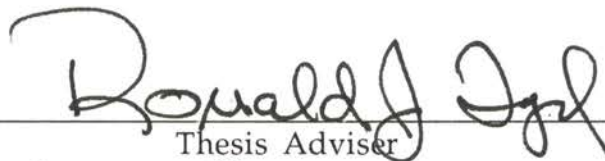
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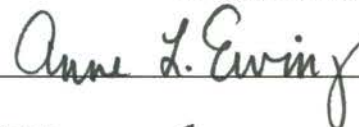
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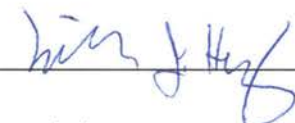
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## CHAPTER I

### Organization of Dissertation

Plant Taxonomy or Systematics is a multifaceted discipline founded on the understanding and interaction of the many conceptual levels of plant biology. This dissertation summarizes three studies that were selected to expose the investigator to several facets of the discipline. Each part is an independent venture and represents a different type of taxonomic work.

In Part I, a DELTA character list is presented. It was produced for the Flora of Oklahoma Project and is to be used for the generation of descriptions of heads for the genera and species of the Asteraceae within Oklahoma. Part II is a morphometric (or numerical-taxonomic) investigation of the species of *Pappophorum* (Poaceae). Part III describes the results of a floristic survey of the Boehler Seeps and Sandhills Preserve in southeastern Oklahoma.

To enhance readability and to facilitate submission for publication, each section or part is complete in itself and written in the format traditionally used in taxonomic journals or floras. It is anticipated that Part I will be incorporated into the *Flora of Oklahoma*, Part II will be submitted to *Systematic Botany*, and Part III will be submitted to the *Proceedings of the Oklahoma Academy of Sciences*.

PART I

DELTA  
CHARACTER LIST  
FOR THE  
ASTERACEAE  
OF OKLAHOMA

## CHAPTER II

### Introduction

"The family Compositae or Asteraceae has attracted, fascinated and even repelled botanists for over two centuries."

V.H. Heywood

Oklahoma has tremendous climatic and geological diversity. Twenty-six geomorphic provinces and 19 land resource areas have been described (Johnson *et al.*, 1979; National Resources Conservation Service, 1992). The state's environmental diversity is reflected in its floristic diversity. Plants characteristic of the Gulf Coastal Plain, Ouachita Uplands, Ozark Plateau, Great Plains, southwestern deserts, and Rocky Mountain foothills can be found within the state. Oklahoma ranks second among all states in the number of vascular plant families with 172 that encompass some 850 genera and 2,600 species (Tyrrel *et al.*, 1994).

A significant component of this flora is the Asteraceae or composite family. Representing approximately 12-13% of the genera and species in the state, it comprises some 104 genera and 350 species (Waterfall, 1969; Taylor and Taylor, 1994). All taxa exhibit the family's characteristic head inflorescence with its distinctive morphological features.

A specialized terminology has evolved to describe the features of the composite head and must be dealt with by the authors of taxonomic manuals such as the forthcoming *Flora of Oklahoma*. State taxonomists writing this

treatise have adopted the use of DELTA (DEscriptive Language for TAXonomy, Dallwitz and Paine, 1986), which is an automated description/identification program that provides a standardized format for taxonomic descriptions by using a coded list of characters. Families such as the Asteraceae require the generation of specific character lists which cover their specialized structures and terminology. The work summarized here was conducted in conjunction with the Flora of Oklahoma Project. The objectives were: 1) to create a DELTA-based character list for the features of the heads of Oklahoma composites, and 2) generate descriptions of the heads of representative genera and species of the family. The products of this research effort -- character list and taxon descriptions -- were submitted to the editorial board of the project for subsequent use by contributing taxonomists.

## CHAPTER III

### Literature Review

#### Ecogeography of Oklahoma and Need for a Modern Taxonomic Treatment

With respect to climate, geology, geography and topography, Oklahoma is quite diverse. Mean annual temperatures across the state range from 18° in the south to 14°C at the western end of the Panhandle (Ruffner, 1980). average length of the growing season varies from 168 to 225 days. rainfall amounts vary as well, from 142 cm per year in the southeast to around 38 cm per year at the western end of the Panhandle. The state is occasionally subjected to periods of flooding and drought which vary in degree and duration. Another predominant climatic feature of Oklahoma is the presence of prevailing winds. They are primarily from the south, but northerly winds dominate during the winter months (Ruffner, 1980).

In addition to having diverse climatic regimes, the state also has complex geology. The oldest exposed geological strata are Precambrian granites and rhyolites (Johnson *et al.*, 1979). They occur only in the Arbuckle Mountains of Murray County, and small outcrops in Mayes County. Other principal mountain ranges, in addition to the Arbuckles, are the Wichita Mountains, located primarily in Comanche County and composed principally of igneous rocks such as granite, rhyolite and gabbro from the Cambrian Period, and the Ouachita Mountains in Le Flore and McCurtain Counties

composed primarily of sedimentary rocks such as shale, sandstone, limestone, coal, and chert from the Ordovician, Devonian-Silurian, Mississippian, and Pennsylvanian Periods (Johnson *et al.*, 1979).

Oklahoma's environmental diversity is reflected in its floristic diversity. Plants characteristic of the Gulf Coastal Plain, Ouachita Uplands, Ozark Plateau, Crosstimbers, Tallgrass Prairie, Mixed Grasslands, Great Plains, Mesquite Grasslands, southwestern Deserts, and Rocky Mountain Foothills can be found within the state. Oklahoma ranks second among all states in the number of vascular plant families, but lacks a modern, comprehensive manual for the identification of the 172 families, 850 genera, and 2,600 or more species present (Tyrl *et al.*, 1994).

Biologists and others needing to identify Oklahoma's plants must rely upon manuals for the floras of adjacent states or regional treatments, e.g., Fernald, 1950; Correll and Johnston, 1979; Great Plains Flora Association, 1986. Because none of the available manuals encompasses all of the state's flora, several are required to identify taxa. A comprehensive manual for the state as a whole is needed due to the complexity of the state's flora and its plant communities. Such a manual would benefit a variety of individuals such as: agronomists, botanists, ecologists, farmers, foresters, ranchers, range managers, recreationists, soil conservationists, veterinarians, wildflower enthusiasts, and wildlife biologists. Agricultural and biological research, as well as effective land management and development, are dependent upon the rapid and accurate identification of economic and biologically important plants. Thus, a comprehensive taxonomic manual for the identification of vascular plants is an indispensable tool for the state's citizens.



## Floristic Work in Oklahoma

Floristic projects in Oklahoma have been quite varied with respect to coverage and approach (Table 1). A number of treatments of the flora of Oklahoma have involved keys and/or descriptions of taxa (White, 1901; Stevens, 1916; Stemen and Myers, 1937; Waterfall, 1952; Tyril *et al.*, 1994). Some works have been produced as aids for plant taxonomy and similar courses (Goodman, 1958) and others as tools for quick identification and use by the public (McCoy, 1968, 1976, 1978, 1980, 1981, 1987). In addition, numerous individuals have produced and/or contributed to the flora of various counties within the state. While their work is significant and has contributed much to the knowledge of the flora and its distribution within the state, it is beyond the scope of this project to summarize their contributions. It is through their work that an annotated checklist of the vascular flora was generated (Taylor and Taylor, 1989, 1991, 1994).

The first historical account of the flora of Oklahoma appeared before statehood in 1907. P.J. White (1901) made a detailed list of the taxa in Oklahoma Territory. The work, a master's thesis titled *A Study of the Flora of Oklahoma*, was submitted to the faculty at the University of Oklahoma, Norman. Essentially a list of names, it lacked keys and descriptions of taxa. Because the scope of the work was limited to the Oklahoma Territory, not all of what we know as Oklahoma today was included.

The individual credited with the first intensive study of the entire state's flora is G.W. Stevens (1916). In *The Flora of Oklahoma*, he listed 134 families, 595 genera and over 1600 species and provided keys and descriptions for genera. Keys to species and their distributions were also

Table 1. Individuals producing taxonomic treatments of the flora of Oklahoma. Authors of floristic treatments of counties excluded.

Name	Year	Title of Work
P.J. White	1901	<i>A Study of the Flora of Oklahoma</i>
G.W. Stevens	1916	<i>The Flora of Oklahoma</i>
T.R. Stemen & W. S. Myers	1929	<i>Spring Flora of Oklahoma with Key</i>
T.R. Stemen & W. S. Myers	1937	<i>Oklahoma Flora</i>
U.T. Waterfall	1952	<i>Keys to the Flora of Oklahoma</i> †
G.J. Goodman	1958	<i>Keys to the Spring Flora of Central Oklahoma</i>
D. McCoy	1968	<i>A Study of Flowering Plants</i>
D. McCoy	1976	<i>Roadside Flowers of Oklahoma, Vol. I</i>
D. McCoy	1978	<i>Roadside Flowers of Oklahoma, Vol. II</i>
D. McCoy	1980	<i>Roadside Wild Fruits of Oklahoma</i>
D. McCoy	1981	<i>Roadside Trees and Shrubs of Oklahoma</i>
D. McCoy	1987	<i>Oklahoma Wildflowers</i>
R.J. Taylor and C.E.S. Taylor	1989	<i>An Annotated List of the Ferns, Fern Allies, Gymnosperms and Flowering Plants of Oklahoma</i> ‡
R.J. Tyrl, S.C. Barber, P. Buck, J.R. Estes, P. Folley, L.K. Magrath, C.E.S. Taylor, & R.A. Thompson	1994	<i>Identification of Oklahoma Plants</i>

† Subsequent editions in 1962, 1966, 1969

‡ Subsequent editions in 1991, 1994

given, however, descriptions were lacking. His work was presented as a thesis to the faculty at Harvard University; unfortunately, it was never published in the scientific literature or as a book (Stevens, 1916; Tyrl *et al.*, 1994).

T.R. Stemen and W. S. Myers's (1937) publication, *Oklahoma Flora*, was an illustrated manual listing 147 families, 640 genera and 1626 species with keys and brief descriptions for family, genera, and species. This work, designed for high school and university biology courses, expanded their previous publication *Spring Flora of Oklahoma with Key* (Stemen and Myers, 1929). It represented a significant contribution over previously published floras, with the critical omission of the graminoid families of Cyperaceae, Juncaceae, and Poaceae.

The first publication, comprehensive in area covered and taxa included, is the *Keys to the Flora of Oklahoma* by U.T. Waterfall in 1960. Subsequent editions appeared in 1962, 1966 and 1969. Versions that appeared in 1972 and 1979 are new printings and not true revisions (Tyrl, *personal communication*). Waterfall's treatment provided a key to the vascular flora of the state and has been the primary reference for students and botanists for the last 30 years. As the title indicates, his treatment was only a series of keys to families, genera, species and infraspecific taxa. It lacked descriptions at all levels.

A number of taxonomic works providing treatments to portions of Oklahoma's flora have been written. As a classroom aide for use in his taxonomy classes at the University of Oklahoma, G. Goodman (1958) published his *Keys to the Spring Flora of Central Oklahoma*, which provided keys without descriptions for families, genera and species. It is extremely restricted in scope including only plants known to flower before the first of

June in the central part of the state and as such covered only 86 families, 320 genera and 622 species (Goodman, 1958). Likewise, D. McCoy produced *A Study of Flowering Plants* (1968, 1976a) for use in his taxonomy classes at Cameron University and East Central State University, but unlike Goodman's text, McCoy's covered a portion of north central Texas as well as central Oklahoma. In terms of presentation, it is much the same. Keys to 102 families, 397 genera and 856 species are given with descriptions lacking for all levels. Some descriptions are given for representative families but not all; descriptions are also separated from the keys (McCoy 1968, 1976a). In addition, McCoy published a number of small, popular texts (1976b, 1978, 1980, 1981, 1987). Although their coverage was limited in scope, they provided color photographs for quick roadside identifications of the state's most common and showy taxa.

Since the last edition of the *Keys to the Flora of Oklahoma* (Waterfall, 1969) appeared, there have been numerous additions to the list of taxa for the flora of Oklahoma. A recent treatment of the state's flora has been an annotated checklist (Taylor and Taylor 1989, 1991, 1994). It included all of the taxa found in the state including those discovered or introduced since the last edition of Waterfall's *Keys to the Flora of Oklahoma*. In addition, it also compiled common names, habit, habitat, and distribution for each taxon as well as changes in nomenclature and classification.

When one explores the wealth of information in the floristic literature of Oklahoma, it becomes apparent that taxonomic descriptions are needed. Such descriptions are often vital in determining whether the correct identification of an unknown plant has been made. The Flora of Oklahoma Project was initiated in the fall of 1983 by state taxonomists in order to write and publish a comprehensive taxonomic treatment for the identification of

the vascular flora of Oklahoma. The work will include the much needed taxonomic descriptions as well as dichotomous keys, illustrations, and brief discussions of the taxonomy, nomenclature, and ecology of each taxon. In order to accomplish its objective, the directors of the project asked taxonomists in the state to contribute their time and knowledge to construct character lists and to develop keys and descriptions for families, genera, and species.

As a first step, the project's editorial board published a key to families (Tyrl *et al.*, 1994), and began writing descriptions for each. The board adopted the use of DELTA to facilitate the development of these descriptions. DELTA (DEscriptive Language for TAXonomy; Dallwitz and Paine 1986) is an automated description/identification program that provides a standardized format for taxonomic descriptions by using a coded list of characters. The coded list of characters for a taxon also can be stored to aid in the identification of unknown specimens via an interactive system. It allows for the storage of taxon-based data for retrieval and manipulation, and the generation of a data-matrix for numerical taxonomic investigations.

The editorial board assigns families or groups of families to individual taxonomists who are asked to contribute descriptions, keys, and special character lists when necessary. The descriptions will contain not only technical information about the group's morphology, but where appropriate, illustrations detailing salient features; discussions of habitat; geographical distribution; time of flowering and fruiting; economic significance; and if introduced, comments about origin and distribution worldwide.

## Introduction to the Asteraceae

The Asteraceae or Compositae are the largest family of flowering plants. Approximately one-tenth of all flowering plants are members of the Asteraceae with the Orchidaceae a close second (Cronquist, 1980). It has worldwide distribution, absent only from the Antarctic mainland (Bremer, 1994). Composed of 3 subfamilies, 17 tribes, 1535 genera and over 23,000 species worldwide (Bremer, 1994), taxa are largely herbaceous in the temperate zones, with shrubs, trees, or vines occurring in semiarid regions of the tropics and subtropics.

In Oklahoma, the family is represented by 2 subfamilies: Asteroideae and Cichorioideae. The third subfamily, the Barnadesoideae is restricted to South America (Bremer and Jansen, 1992). The Asteroideae, having 10 tribes worldwide, is represented by 8 tribes in the state; while the Cichorioideae, with 6 tribes, is represented by only 3. There are approximately 104 genera and 350 species in the state (Table 2; Waterfall, 1969; Taylor and Taylor, 1994).

The family is a well-defined taxon whose members are united by the unique nature of their inflorescence and the consistency of their floral structure/morphology. The inflorescence is composed of flowers, or florets, that are aggregated into a head, or capitulum. Due to the uniformity of the inflorescence, recognition of tribes and genera can be difficult in some instances. This has led to the use of small scale or trivial characters which are often suspected as not being valid or significant for distinguishing among taxa (Heywood *et al.*, 1977).

Table 2. Tribes & Genera of Oklahoma Composites following Bremer's (1994) Classification.

ANTHEMIDEAE	GNAPHALIEAE	<i>Spilanthes</i>
<i>Achillea</i>	<i>Antennaria</i>	<i>Thelesperma</i>
<i>Anthemis</i>	<i>Evax</i>	<i>Verbesina</i>
<i>Artemisia</i>	<i>Facelis</i>	<i>Xanthium</i>
<i>Chrysanthemum</i>	<i>Gnaphalium</i>	<i>Zinnia</i>
<i>Matricaria</i>		
<i>Solvia</i>		
<i>Tanacetum</i>		
ASTEREAE	HELENIEAE	LACTUCEAE
<i>Aphanostephus</i>	<i>Bahia</i>	<i>Agoseris</i>
<i>Aster</i>	<i>Dyssodia</i>	<i>Cichorium</i>
<i>Astranthium</i>	<i>Flaveria</i>	<i>Crepis</i>
<i>Baccharis</i>	<i>Gaillardia</i>	<i>Hieracium</i>
<i>Boltonia</i>	<i>Haploesthes</i>	<i>Krigia</i>
<i>Chaetopappa</i>	<i>Helenium</i>	<i>Lactuca</i>
<i>Chrysopsis</i>	<i>Hymenopappus</i>	<i>Lygodesmia</i>
<i>Chrysanthamnus</i>	<i>Hymenoxys</i>	<i>Pinaropappus</i>
<i>Conyza</i>	<i>Marshallia</i>	<i>Prenanthes</i>
<i>Erigeron</i>	<i>Palafoxia</i>	<i>Pyrrhopappus</i>
<i>Euthamia</i>	<i>Pectis</i>	<i>Sonchus</i>
<i>Grindelia</i>	<i>Pericome</i>	<i>Taraxacum</i>
<i>Gutierrezia</i>	<i>Pseudoclapia</i>	<i>Tragopogon</i>
<i>Haplopappus</i>	<i>Psilostrophe</i>	
<i>Heterotheca</i>	<i>Tagetes</i>	
<i>Machaeranthera</i>		PLUCHEAE
<i>Pityopsis</i>		<i>Pluchea</i>
<i>Prionopsis</i>		
<i>Solidago</i>		
<i>Townsendia</i>		
<i>Xanthisma</i>		
CARDUEAE	HELIANTHEAE	SENECIONEAE
<i>Arctium</i>	<i>Ambrosia</i>	<i>Cacalia</i>
<i>Carduus</i>	<i>Berlandiera</i>	<i>Erechtites</i>
<i>Carthamus</i>	<i>Bidens</i>	<i>Senecio</i>
<i>Centaurea</i>	<i>Coreopsis</i>	
<i>Cirsium</i>	<i>Cosmos</i>	
<i>Onopordum</i>	<i>Dracopsis</i>	
	<i>Echinacea</i>	
	<i>Eclipta</i>	
	<i>Engelmannia</i>	
	<i>Franseria</i>	
	<i>Galinsoga</i>	
	<i>Helianthus</i>	
	<i>Heliopsis</i>	
	<i>Iva</i>	
	<i>Lindheimera</i>	
	<i>Melampodium</i>	
	<i>Parthenium</i>	
	<i>Polymnia</i>	
	<i>Ratibida</i>	
	<i>Rudbeckia</i>	
	<i>Silphium</i>	
EUPATORIEAE		VERNONIEAE
<i>Brickellia</i>		<i>Elephantopus</i>
<i>Eupatorium</i>		<i>Vernonia</i>
<i>Liatris</i>		
<i>Mikania</i>		

## Morphology - Specialized Terminology

A number of specialized terms have evolved to describe the unique floral structure of composites. These terms encompass all conceptual levels of complexity from floral organs to individual florets to the entire head. These terms are reviewed in the following paragraphs.

### Inflorescence

When examining a composite, the first structure that many people mistakenly believe to be a flower is actually an inflorescence composed of many small flowers known as florets. This inflorescence type, known as the head or capitulum, is so unique that it serves to unite all members of the family. It is thought to be a condensed stem axis with few to numerous florets borne on a common receptacle formed from the axis and wholly or partially subtended by bracts.

Four types of florets -- ligulate, ray, disk, bilabiate -- occur in the family; they will be described below. Heads differ in the types of florets that may be present, for example, they can be composed of ligulate florets only, and as such are termed ligulate heads. Only taxa of the Lactuceae have ligulate heads (Heywood *et al.*, 1977; Cronquist, 1981). In contrast, heads can have a combination of ray and disk florets and be termed radiate heads, or heads can possess disk florets only. Such heads are termed discoid (Heywood *et al.*, 1977; Cronquist, 1980). Radiate and discoid heads are common in the family and found in various tribes. Heads with bilabiate florets are characteristic of most members of the Mutisieae and some members of the Barnadesieae (Bremer,



1994; Zomlefer, 1994); a specific term to describe their heads is not used generally. These two tribes are not represented in Oklahoma.

### Involucre

Involucre is the collective term for the bracts subtending and surrounding the florets of the head. The involucre shows great variety in form and received considerable attention by early taxonomists studying the Asteraceae (Small, 1918). Individually, the bracts are referred to as phyllaries. They vary in arrangement, color, shape, size, and texture. They also may possess spines or other elaborations. Phyllaries are generally arranged in one or more rows, but fusion can occur in varying degrees, sometimes resulting in a bur as in *Xanthium*.

### Receptacular Bracts

Bracts also may occur on the surface of the receptacle associated with individual florets. Individually they are called pales or receptacular bracts; collectively they are termed the chaff. Heads are described as chaffy or not chaffy. They vary in nature from bristles to broad scales, in texture from hyaline to cartilaginous, and in length from shorter to longer than florets.

### Florets

As noted above, the head or capitulum is composed of many small flowers inserted on a common receptacle. The flowers which compose the head are referred to as florets, of which there are four types: disk, ray, ligulate, and bilabiate. Some authors' treatments of the Asteraceae, e.g. Fernald (1950), Correll and Johnston (1970), and Jones and Luchsinger (1979) treat ray and

ligulate florets as synonyms. Other synonyms of ray florets include strap florets, ligules, and marginal florets, so named for their appearance or position on the perimeter of the head. Other authors (Heywood, 1978; Cronquist, 1981; Great Plains Flora Association, 1986; Mabberley, 1987) recognize ray and ligulate florets as two distinct types. Fundamentally, their morphology is similar, yet they differ in sexuality and number of corolla lobes.

Disk Florets. The first major floret type in the Asteraceae is known by two names which describe either its shape or position. It gets the name tube floret from its generally tubular corolla with regular symmetry, and the term disk (or disc) floret from its central position in the head. The corolla has 4 or 5 apical lobes and varies in shape from campanulate to funnelform or salverform to tubular. Florets of this type are perfect or functionally staminate.

Heads can be composed solely of disk florets; as such, they are termed *discoïd*. Disk florets can also be present in the centers of heads with ray florets at the margins. Heads of this type are called *radiate* and are most often associated with the composite family.

Ray Florets. The corollas of ray florets are zygomorphic. They are tubular at the base and become flattened or spreading apically to form a limb. While the tube remains rather constant in morphology, notable variation does exist in the corolla limb. It may be unlobed or have as many as four lobes. Bremer (1994) and some other taxonomists (Heywood, 1978; Correll and Johnston, 1979; Cronquist, 1981) make a distinction between ray florets with three lobes and four lobes. They prefer to call the former "true" ray florets and the latter simply "4-lobed" florets. Bremer (1994) states that true

ray florets will have 3 lobes and 4 veins and those with 4 lobes will have 5 veins, however, this pattern can be obscured by the presence of additional veins. In this treatment, a conservative stance is taken (cf. Cronquist, 1981). Ray florets are considered to be typically 3-lobed, but 2-lobe, 4-lobe or unlobed corollas occur in some taxa. All ray florets, however, are pistillate or sterile.

In general, heads are not composed solely of ray florets, except for the pistillate heads of a few dioecious taxa (Cronquist, 1980). There is no term to describe heads with ray florets only. Normally, ray florets are found at the periphery of heads with disk florets in the centers; such heads are termed *radiate*.

A variation of ray florets with the limb much reduced or absent does occur (Cronquist, 1980; Cronquist *et al.*, 1994). Heads bearing this type of tubular ray floret are termed *disciform* and have the modified ray florets at the margins and disk florets in the centers. Superficially, they resemble heads with disk florets only. The term discoid is sometimes applied incorrectly to this head type. The tubular-shaped corolla of this variant ray floret differs from the corolla of disk florets in that it lacks the apical lobes characteristic of disk corollas and is often more slender (Cronquist, 1980; Cronquist *et al.*, 1994). Typically, these florets are pistillate.

Ligulate Florets. Similar in appearance to ray florets, ligulate florets are also zygomorphic and composed of a tube at the base with a flattened, spreading limb. In general, tube morphology does not vary. Unlike ray florets, ligulate florets do not vary in the number of corolla lobes; they have 5 lobes and 6 veins. Florets of this type are characteristic of and almost entirely restricted to members of the Lactuceae; such heads are referred to as ligulate heads. (Cronquist, 1981; Bremer, 1994). They are perfect.

Bilabiate Florets. As its name implies, the corolla of a bilabiate floret is strongly 2-lipped or 2-limbed. The outer limbs, which can be long or short, bear 3 lobes while the inner limbs possess 2 lobes (Correll and Johnston, 1979; Bremer, 1994). Heads with bilabiate florets are characteristic of most members of the Mutisieae and some members of the Barnadesieae (Bremer, 1994; Zomlefer, 1994); a term to describe their heads is not used generally. The tribes Barnadesieae and Mutisieae are not represented in Oklahoma. Bilabiate florets generally are perfect.

### Pappus

Sepals may be present or absent in the Asteraceae. When present, they are highly modified and collectively referred to as the pappus. It is highly diverse in its morphology and can occur in a variety of forms: as a low crown; as a cluster of awns, scales, or bristles; or as a combination of forms. The pappus segments can occur in one or more whorls. The pappus is located at the apex of the achene and may serve as an aid in fruit dispersal, e.g., the capillary bristles of *Taraxacum* for wind dispersal and the short awns of *Bidens* for animal dispersal.

### Achenes

The achenes of composites arise from an inferior ovary composed of two carpels and contain a single ovule (Bremer, 1994). They are dry and indehiscent at maturity. They are usually wind- or animal-dispersed (Cronquist, 1981; Zomlefer, 1994). Although the fruit type is traditionally described as an achene, some taxonomists, e.g. Heywood (1978) and Bremer (1994), prefer to use cypsela. A cypsela differs from an achene in that it is derived from an inferior ovary, whereas an achene, in the strict sense, is

derived from a superior ovary. Again, in this treatment a conservative approach is taken and the term achene, in the broad sense, is used.

Achenes of composites can be angular or rounded; straight or curved. Ornamentation in the form of ribs or wings may be present. The presence or absence of pappus at maturity can be noted by observing the apex of the achene. A constriction can occur between the apex of the achene and the pappus. If such a constriction occurs, the achenes are said to be beaked; if the constriction is absent, the achenes are not beaked.

### Stamens

The stamens of the Asteraceae are borne on the corolla tube and alternate with the corolla lobes. The filaments are free, but the dorsifixed anthers are fused by their lateral margins forming a tube or cylinder. In members of the subtribe Ambrosiinae, they are connivent (Cronquist, 1980). The filaments remain free. The apices and bases of pollen sacs vary in shape and may be modified with specialized sterile appendages; the shape and presence of these appendages can play a role in identification and classification (Bremer, 1994). Anther color varies from yellow to purple to black and can be used in tribal classification, e.g., most Heliantheae have black anthers (Bremer, 1994).

In a strict sense, true staminate florets, i.e., florets possessing only stamens, do not normally occur in the Asteraceae (Cronquist, 1980). The pistil is present albeit sterile. Its styles, though reduced and undivided, are present and elongate to expel the pollen. Thus the disk florets are functionally staminate.

## Styles

One style is characteristic of the Asteraceae. Typically it is divided into two short or long branches. In a few taxa it is not divided while in others each branch is bifid (Cronquist, 1980; Bremer, 1994). Style branches vary in a number of ways: indumentation type and position, length, shape, degree of bifurcation, and position of stigmatic surface. The indumentation type and its arrangement is important because of its role in sweeping or pushing pollen out of the anther tube as the style elongates. Because of this variability, style branch morphology has probably been the most important character in tribal classification of the composites (Bremer, 1994). Typically, however, it is the salient features of the style branches of the perfect florets that are used (Bremer, 1994).

Functionally staminate florets possess much reduced and often undivided style branches. In pistillate florets, the sterile hairs that aid in sweeping out pollen are much reduced as the anther tube is absent or much reduced. Thus, many of the features that are important in the classification of some taxa may not be present in imperfect florets.

The stigma is not well delimited from the style in composites. It may cover the adaxial (inner) surface of each style branch or be present as narrow marginal bands on the adaxial surface of each branch. The stigmatic surface, while an organized tissue or region, is not distinct from the style and normally is seen only with a good dissecting scope or exceptionally good hand lens. Traditionally, the term stigma is not used when describing composites.

The base of the style is usually glabrous and swollen. It is often inserted in a thickened cup- or scale-shaped nectary that sits atop the ovary.

This swollen base is sometimes referred to as a stylopodium (Cronquist, 1981; Bremer, 1994).

An interesting feature of composite styles is the presence of hairs specialized to play a role in “sweeping” pollen out of the fused anthers. Typically referred to as a pollen-presentation mechanism, these hairs are not restricted to the composites, and can be found in most families of the Campanulales (Leins and Erbar, 1990). In some taxa of the Asteraceae, the mechanism is a ring of antrorse hairs around the style immediately below the junction of the branches. In other taxa, the hairs form truncate brushes at the end of each style branch, while in others, antrorse hairs cover the abaxial surfaces of each branch. Other mechanisms occur as well. As the anthers dehisce introrsely, they fill the center of the stamen tube with pollen. At this stage, the unexpanded style is very short and the two style branches are pressed together, not separated (Heywood, 1978; Leins and Erbar, 1990; Zomlefer, 1994). As the style elongates, it pushes the pollen out of the tube exposing it to visiting pollinators. The hairs of the pollen presentation mechanism are especially important in sweeping the pollen along. The style continues to elongate, and only much later do the style branches separate, thus exposing the stigmatic surfaces (Heywood, 1978; Leins and Erbar, 1990; Zomlefer, 1994).

#### Subtribal & Tribal Classification of the Asteraceae

The unique inflorescence of the Asteraceae has caught the attention of naturalists and taxonomists from the very beginnings of history. Theophrastus, c. 370-285 BC, recognized as the “father of botany” is credited with recognizing the composites as a class and members of at least two groups within it: the chicory-like plants of the tribe Lactuceae and the thistle-like

plants of the tribe Cardueae (Small, 1917; Jones and Luchsinger, 1979; Bremer, 1994). Pedacius Dioscorides, a Roman military surgeon, wrote *Materia medica* which included descriptions of approximately 600 species of medicinal plants. In this work, he recognized a grouping of *Sonchus*, *Cichorium* and *Chondrilla*, all members of the modern Lactuceae (Small, 1917; Jones and Luchsinger, 1979). During the 16th century, several German herbalists: Otto Brunfels, Valerius Cordus and Leonhard Fuchs, advanced the development of groups of composites by writing descriptions of or creating new taxa. Andrea Ceasalpino (1519-1603), an Italian botanist, was the first to recognize the composites as a distinct group. Caspar Bauhin, a contemporary of Ceasalpino, failed to recognize the composites as a family but did recognize some of the previously described groups; e.g., Cichorieae, Cynareae, Anthemideae, and Astereae; he also grouped several genera of the modern Gnaphalieae together. A 17th century botanist, Christopher Knaut, is reported to be the first to use the name Compositae (Small, 1917; Jones and Luchsinger, 1979).

The dominant systematist in the 18th century was the Swedish born botanist, Carolus Linnaeus, known today as the "father of taxonomy". In his later years, he was known as Karl von Linnè. He made several attempts to classify the composites and made no progress (Small, 1917). He departed from his sexual system of classification to create a distinct class, Syngenesia, that united most of the genera of the composites as well as others outside the family such as *Lobelia*, *Viola*, and *Impatiens* based on the presence of an anther tube or ring formed by fusion of their lateral margins (Small, 1917; Cronquist, 1955). Several other botanists during this century made attempts at classifying the composites with little or no originality over previously published systems (Small, 1917).



The modern tribal concept of the composites dates to the 19th century, to the founder of synantherology, Henri Cassini (Small, 1917; Cronquist, 1955; Bremer, 1994). Synantherology, the study of the composites, is based on Cassini's name for the family, Synantheraceae (Willis, 1966). The term means "with anthers together or fused", emphasizing one of the notable characteristics of the family. In 1816 he published a diagram showing interrelationships among the 19 tribes he had described (cf. Bremer, 1994). Most of them are still recognized today. Interestingly, his work was published in a rather haphazard fashion in the *Dictionnaire des sciences naturelles dans lequel on traite méthodiquement des différents êtres de la nature* between 1816 and 1830, and in the [Nouveau] *Bulletin des sciences par la Société Philomatique de Paris* between 1812 and 1821 (Cassini, 1995a). Because of his unorganized mode of publishing, his work did not make much of an impact until others began assembling his treatments and using them (Cronquist, 1977). His works have been compiled as facsimiles and are available as a 3-volume work (Cassini, 1975; Cassini, 1995a; Cassini, 1995b).

In spite of Cassini's contributions, the single most influential work on the Asteraceae is that of George Bentham (1873) which appeared in his *Genera Plantarum*. His overall tribal classifications have persisted through time, although circumscriptions of some tribes have been altered considerably (Cronquist, 1977; Bremer, 1994). A modern, cladistic treatment of the family was published in 1994 by Bremer. In his classification system, he recognized 3 subfamilies and 17 tribes. A comparison of Bentham's tribes with those of Bremer reveals many similarities (Table 3). Most of the tribal names of Bentham were conserved. Only two were replaced; Cichorieae and Cynareae became Lactuceae and Cardueae. For some genera, their taxonomic position

Table 3. A Comparison of Asteraceae Tribes in Oklahoma: Bentham (1873) vs. Bremer (1994)

Tribes	Authors		Comments
	Bentham	Bremer	
Anthemideae	+	+	
Asteraceae	+	+	
Cardueae		+	includes Cynareae of Bentham
Cichorieae	+		see Lactuceae
Cynareae	+		see Cardueae
Eupatorieae	+	+	
Gnaphalieae		+	included in Inuleae of Bentham
Helenieae	+	+	
Heliantheae	+	+	Bremer's circumscription narrower than Bentham's; some taxa moved to Helenieae
Inuleae	+		recognized by Bremer; circumscription narrower; not in Oklahoma
Lactuceae		+	includes Bentham's Cichorieae
Plucheeae		+	included in Inuleae of Bentham
Senecioneae	+	+	Bremer's circumscription narrower than Bentham's; some taxa moved to Helenieae
Vernonieae	+	+	

changed. Circumscriptions of the Heliantheae, Helenieae, Inuleae, and Senecioneae were altered. For example, *Marshallia* in the Heliantheae of Bentham was repositioned in the Helenieae of Bremer. Likewise, some members of the Senecioneae were moved to the Helenieae. Bremer's circumscription of the Inuleae was narrowed forming the Gnaphalieae, Inuleae and Plucheeae. Only two tribes of this grouping are found within Oklahoma -- the Gnaphalieae and Plucheeae.

## CHAPTER IV

### Methodology

In order to become acquainted with the terminology used to describe composites, family descriptions in regional floras (Correll and Johnston, 1979; Cronquist, 1980; Great Plains Flora Association, 1986) as well as general reference texts (Heywood, 1978; Jones and Luchsinger, 1979; Cronquist, 1981; Bremer, 1994; Zomlefer, 1994) were examined. In addition to published descriptions, specimens from the Oklahoma State University Herbarium (OKLA) were examined. A list of characters describing the specialized inflorescence of the composites was compiled in the DELTA format for CHARS. As appropriate for each character, a number of character states were generated to encompass all of the variation within the family as it is represented in Oklahoma (Appendix A).

Each character was then coded as to the type of character (TE for characters requiring textual inputs; RN for characters requiring real number inputs) or the number of character states. Once the specifications of each character were noted, the information was recorded in SPECS (Appendix B). Once the character list was generated, the characters and character states of selected species were coded in the DELTA format for ITEMS (Appendix C). Specimens from OKLA were examined as ITEMS were developed to insure that all variability was accounted for in the character list. The character list was revised as necessary and additional taxa coded. TONAT (Appendix D)

was used to generate natural language descriptions from ITEMS. The descriptions were generated and edited; they are presented in Chapter V.

## CHAPTER V

### Results

Two species of composites were selected to test the fluidity and thoroughness of the natural language descriptions generated by TONAT. A taxon representing the typical radiate composite head was chosen, *Achillea millefolium* L. In addition, *Ambrosia trifida* Torr., was selected to test the use of CHARS for dioecious taxa. CHARS, SPECS, and ITEMS were revised as necessary to produce the descriptions presented below.

The DELTA programs generated by this study will be submitted to the Flora of Oklahoma editorial board for their use in generating descriptions for the Asteraceae of Oklahoma.

The descriptions which follow contain only those features of the heads or inflorescences. Vegetative characters for *Achillea millefolium* and *Ambrosia trifida* were not included and will be supplied by future individuals working on taxonomic treatments of the various tribes or genera.

#### *Achillea millefolium* L. Yarrow

**Heads** all alike; 300 or more; in terminal corymbs; held erect; with both ray and disk florets; 3-4.5 mm wide; 4-5 mm long. **Primary peduncles** 4-7 cm long. **Secondary peduncles** 3 mm long. **Phyllaries** all alike; 20-30; in 3 rows. Outer phyllaries imbricate; free; appressed; scarious; lanceolate; 0.5-0.75 mm wide; 1.5-2.5 mm long; scurfy; venation not apparent; of 3 veins; midnerve

stramineous to green; indumentum tomentose; apices rounded; margins stramineous to white; ciliate. Inner phyllaries imbricate; free; appressed; scarious; lanceolate; 1-1.5 mm wide; 2.5-3 mm long; scurfy; venation not apparent; of 3 veins; midnerve stramineous to green; indumentum tomentose; apices rounded; margins stramineous to white; membranous; bases not enclosing outermost achenes. *Ray florets* present; 4; in 1 row; pistillate; fertile. Pappus absent. Corollas deeply 3-lobed; persistent at maturity; reflexed; white to pink; membranous; orbicular; 2-2.5 mm wide; 3-3.5 mm long; 5-veined; glabrous; apices rounded; bases of corolla tubes slightly saccate in fruit. Styles 1.25 mm long. Style branches not lobed; rust or reddish brown; clavate; stigmatic regions forming 2 marginal bands; glabrous. Sterile appendages present; apices truncate. Style bases not swollen; nectaries present; glabrous. Sweeping hairs absent. Achenes present; developed; golden brown to brown; smooth; angular and flattened; linear to elliptic; 0.4-0.5 mm wide; 1.25 mm long; glabrous; ribs absent; wings present; continuous from apices to bases; beaks absent; bases not attached to subtending receptacular bracts. *Disk florets* present; 20 or more; perfect; fertile. Pappus absent. Corollas 5-lobed; persistent at maturity; white to pink; membranous; tubular; 0.6 mm wide; 2.25 mm long; glabrous; lobes reflexed; apices acute; bases of corolla tubes slightly saccate in fruit. Stamens present; 4.5 mm long. Anthers stramineous to yellow; straight; 0.2 mm wide; 1.25 mm long; apical appendages present; curved; spatulate; 0.2 mm wide; 0.2-0.3 mm long; bases rounded. Filaments flattened, glabrous. Styles 1-2 mm long. Style branches present; not lobed; rust to reddish brown; clavate; stigmatic regions forming 2 marginal bands; glabrous. Sterile appendages absent; apices truncate. Style bases not swollen; nectaries present; glabrous. Sweeping hairs absent. Achenes present; developed; golden brown to brown; smooth; angular and

flattened; linear to elliptic; 0.4 mm wide; 1.5 mm long; glabrous; ribs absent; wings present; continuous from apices to bases; beaks absent; bases not attached to subtending receptacular bracts. *Receptacles* conical; solid; surfaces pitted; glabrous. *Receptacular bracts* present; similar in appearance to phyllaries; stramineous green, midribs green and margins stramineous; lanceolate; keeled; 1.5 mm wide; shorter than disk florets; 3.5 mm long; indumentum tomentose; apices acute; margins membranous; bases curved.

One species of *Achillea*, *A. millefolium* L., is found within the state. Classified in the subfamily Asteroideae and the tribe Anthemideae; it is known commonly as yarrow, milfoil, and nosebleed. *Achillea* is widespread in grasslands and open woods and is frequently found in disturbed soils. It flowers in spring and early summer in our area and is native in north temperate regions of Asia, Europe, and North America.

#### ***Ambrosia trifida* Torr. Ragweed**

*Heads* of 2 forms, staminate and pistillate different. *Staminate heads* 300 (or more); in racemes; terminal; pendulous; with disk florets only; 3.5 mm wide; 2 mm long. *Primary peduncles* 6.5 mm long. *Secondary peduncles* 2 mm long. *Phyllaries* all alike; in 1 row; appearing as 1 united phyllary; shallowly or obscurely lobed; fused; spreading; green; membranous; orbicular; 3.25-3.5 mm in diameter; 1.5-2 mm from center to edge; venation conspicuous; of 3 veins; dark, thickened vein-like strips extending from center to margins, located on one side of the phyllaries; indumentum hirsute hairs with pustulate bases, located among veins; apices shallowly or obscurely lobed. *Disk florets* 20 or more; staminate; sterile. Pappus absent. Corollas 5-lobed; persistent at maturity; stramineous to yellow, veins dark; membranous; funnelform; 0.75-1 mm wide; 1.5 mm long; glabrous; lobes



curled inward; apices acute. Stamens 5; 1.5 mm long; fused by anthers. Anthers white to yellow; straight; apical appendages present; curved; subulate; bases rounded. Styles present; divided; 0.75 mm long; included within corolla tubes. Sweeping hairs present; concentrated on tips of style branches. Achenes absent. **Receptacles** flat; hollow. **Receptacular bracts** present or absent; when present, slender and fimbriate-hairy; white; shorter than disk florets. **Pistillate heads** 50-300 (or more); solitary or in pairs; axillary; sessile in axils of bracts or rudimentary leaves below staminate flowers; held erect; not surrounded by secondary involucre; 3.5-4.5 mm wide; 5-7 mm long. **Primary peduncles** absent. **Secondary peduncles** absent. **Phyllaries** present; reticulate with 4 to 8 prominent ridges each ending in small tubercles or short, blunt spines encircling a stout, conic beak (1 mm); fused, forming a bur; stramineous to green with irregular purple spots; indurate; venation not apparent; indumentum hispid hairs with tuberculate bases. **Disk florets** present; one floret per head; pistillate; fertile. Pappus absent. Corollas absent. Stamens absent. Styles present; divided; for most of their length. Style branches present; not lobed; linear; stigmatic regions on adaxial surfaces; glabrous; apices rounded. Sterile appendages absent. Sweeping hairs absent. Achenes present; developed; enclosed within indurate burs formed by the fused phyllaries; rust to black; smooth; lenticular; obovate to elliptic; 1.75-2.75 mm wide; 3.5-4.5 mm long; glabrous; ribs absent; wings absent; beaks absent, although one is present as part of the fused phyllaries not as part of the achene. **Receptacles** not present. **Receptacular bracts** absent.

One variety is recognized in our area, *Ambrosia trifida* var. *texana* Scheele. It is classified in the subfamily Asteroideae and the tribe Heliantheae. *Ambrosia* is considered a weed and can be found throughout the midwest and central United States. It is widespread and frequently found

in moist disturbed sites. Flowering occurs in late summer and fall and is considered to be a major contributor to hayfever in our area.

## CHAPTER VI

### Literature Cited

- Bentham, G. 1873. Compositae. In: G. Bentham and J.D. Hooker. *Genera Plantarum*. 2(1): 163-533.
- Bremer, K. 1994. *Asteraceae: cladistics and classification*. Timber Press, Portland, Oregon.
- Bremer, K. and R.K. Jansen. 1992. A new subfamily of the Asteraceae. *Ann. Missouri Bot. Garden*. 79: 414-415.
- Cassini, H. 1975. Cassini on Compositae, collected from the *Dictionnaire des Sciences Naturelles*. Ed. by R.M. King and H.W. Dawson. Oriole Editions, New York.
- Cassini, H. 1995a. Cassini on Compositae II, collected from the *Bulletin des Sciences par la Societe Philomatique de Paris*. Ed. by R.M. King, P.C. Janaske, and D.B. Lellinger. Missouri Botanical Garden, Saint Louis, Missouri.
- Cassini, H. 1995b. Cassini on Compositae II, collected from the *Journal de Physique, de Chimie, d'Histoire Naturelle et des arts* and from the *Annales des Sciences anaturelles*. Ed. by R.M. King, P.C. Janaske, and D.B. Lellinger. Missouri Botanical Garden, Saint Louis, Missouri.
- Correll, D.S. and M.C. Johnston. 1979. *Manual of the vascular plants of Texas*. The University of Texas at Dallas, Richardson, Texas.

- Cronquist, A. 1955. Phylogeny and taxonomy of the Compositae. *The American Midland Naturalist*. 53(2): 478-511.
- Cronquist, A. 1977. The Compositae revisited. *Brittonia*. 29: 137-153.
- Cronquist, A. 1980. Vascular flora of the southeastern United States, Volume I: Asteraceae. The University of North Carolina Press, Chapel Hill, North Carolina.
- Cronquist, A. 1981. An integrated system of classification of flowering plants. Columbia University Press, New York.
- Cronquist, A., A.H. Holmgren, N.H. Holmgren, J.L. Reveal, and P.K. Holmgren. 1994. Intermountain flora: vascular plants of the Intermountain West, USA. Volume 5: Asterales, by A. Cronquist. The New York Botanical Garden, Bronx, New York.
- Dallwitz, M.J. and T.A. Paine. 1986. User's guide to the DELTA system: A general system for coding taxonomic descriptions. CSIRO Division of Entomology Report No. 13. CSIRO, Canberra.
- Fernald, M.L. 1950. Gray's manual of botany, 8th edition. American Company, New York.
- Great Plains Flora Association. 1986. Flora of the Great Plains. University Press of Kansas. Lawrence, Kansas.
- Goodman, G. 1958. Spring flora of central Oklahoma. University of Oklahoma Duplicating Service, Norman, Oklahoma.
- Heywood, V.H. 1978. Flowering plants of the world. Mayflower Books, New York.
- Heywood, V.H., J.B. Harborne, and B.L. Turner, editors. 1977. The biology and chemistry of the Compositae. Vol. I and II. Academic Press, London, England.

- Johnson, K.S., C.C. Branson, N.M. Curtis, Jr., W.E. Ham, W.E. Harrison, M.V. Marcher, and J.F. Roberts. 1979. Geology and earth resources of Oklahoma. Educational Publication 1. Oklahoma Geological Survey, Norman, Oklahoma.
- Jones, S.B., Jr. and A.E. Luchsinger. 1979. Plant systematics, 2nd edition. McGraw-Hill, New York.
- Leins, P. and C. Erbar. 1990. On the mechanisms of secondary pollen presentation in the Campanulales-Asterales-complex. *Botanica Acta*. 103: 87-92.
- Mabberley, D.J. 1987. The plant-book: a portable dictionary of the higher plants. Cambridge University Press, New York.
- McCoy, D. 1968. A study of flowering plants. Cameron University, Lawton, Oklahoma.
- McCoy, D. 1976a. A study of flowering plants, 2nd edition. Cameron University, Lawton, Oklahoma.
- McCoy, D. 1976b. Roadside flowers of Oklahoma, Vol. I. C & J Printing Co., Lawton, Oklahoma.
- McCoy, D. 1978. Roadside flowers of Oklahoma, Vol. II. McCoy Publishing Co., Oklahoma City, Oklahoma.
- McCoy, D. 1980. Roadside wild fruits of Oklahoma. Oklahoma University Press, Norman, Oklahoma.
- McCoy, D. 1981. Roadside trees and shrubs of Oklahoma. Oklahoma University Press, Norman, Oklahoma.
- McCoy, D. 1987. Oklahoma wildflowers. McCoy Publishing Co., Oklahoma City, Oklahoma.

- National Resources Conservation Service. 1992. Major land resources areas: Oklahoma state map. Distributed by NRCS Office, Stillwater, Oklahoma.
- Ruffner, J.A. 1980. Climates of the United States: National Oceanic and Atmospheric Administration narrative summaries, tables, and maps for each state with overview of state climatologist programs, 2nd edition. Volume 2. Gale Research Company, Detroit, Michigan.
- Small, J. 1917. The origin and development of the Compositae, introduction The New Phytologist. 16(7): 157-177.
- Small, J. 1918. The origin and development of the Compositae, chapter VI - VIII. The New Phytologist. 17(6): 114-142.
- Stemen, T.R. and W.S. Myers. 1929. Spring flora of Oklahoma with key. Harlow Publishing Company, Oklahoma City, Oklahoma.
- Stemen, T.R. and W.S. Myers. 1937. Oklahoma flora. Harlow Publishing Company, Oklahoma City, Oklahoma.
- Stevens, G.W. 1916. The flora of Oklahoma. Doctoral Dissertation. Harvard University, Cambridge, Massachusetts.
- Taylor, R.J. and C.E.S. Taylor. 1989. An annotated list of the ferns, fern allies, gymnosperms and flowering plants of Oklahoma. Southeastern Oklahoma State University Herbarium, Durant, Oklahoma.
- Taylor, R.J. and C.E.S. Taylor. 1991. An annotated list of the ferns, fern allies, gymnosperms and flowering plants of Oklahoma, 2nd Edition. Southeastern Oklahoma State University Herbarium. Durant, Oklahoma.
- Taylor, R.J. and C.E.S. Taylor. 1994. An annotated list of the ferns, fern allies, gymnosperms and flowering plants of Oklahoma, 3rd Edition.

- Southeastern Oklahoma State University Herbarium. Durant, Oklahoma.
- Tyrl, R.J., S.C. Barber, P. Buck, J.R. Estes, P. Folley, L.K. Magrath, C.E.S. Taylor, and R.A. Thompson. 1994. Identification of Oklahoma plants: keys to the vascular plant families of Oklahoma. Flora Oklahoma Incorporated, Norman, Oklahoma.
- Waterfall, U.T. 1952. Keys to the flora of Oklahoma. Oklahoma State University Bookstore, Stillwater, Oklahoma.
- Waterfall, U.T. 1962. Keys to the flora of Oklahoma, 2nd edition. Oklahoma State University Bookstore, Stillwater, Oklahoma.
- Waterfall, U.T. 1966. Keys to the flora of Oklahoma, 3rd edition. Oklahoma State University Bookstore, Stillwater, Oklahoma.
- Waterfall, U.T. 1969. Keys to the flora of Oklahoma, 4th edition. Oklahoma State University Bookstore, Stillwater, Oklahoma.
- White, P.J. 1901. A study of the flora of Oklahoma. Master's Thesis. University of Oklahoma, Norman, Oklahoma.
- Willis, J.C. 1966. A dictionary of the flowering plants and ferns, 7th edition, revised by H.K. Airy Shaw. Cambridge University Press, New York.
- Zomlefer, W.B. 1994. Guide to flowering plant families. The University of North Carolina Press, Chapel Hill, North Carolina.

## PART II

# A MORPHOMETRIC INVESTIGATION OF *PAPPOPHORUM* SCHREBER (POACEAE: CHLORIDOIDEAE: PAPPOPHOREAE)



## CHAPTER VII

### A MORPHOMETRIC INVESTIGATION OF *PAPPOPHORUM* SCHREBER (POACEAE: CHLORIDOIDEAE: PAPPOPHOREAE)

ABSTRACT. A morphometric analysis of 51 characters of 676 herbarium specimens of *Pappophorum* using NT-SYS indicate that recognition of 7 species is warranted in contrast to previous treatments which advocated 8-20. *P. vaginatum*, *P. subbulbosum*, and *P. caespitosum* are conspecific. *P. bicolor*, *P. hassleri*, *P. krapovickasii*, *P. mucronulatum*, *P. pappiferum*, and *P. philippianum* are morphologically distinct species. An eighth taxon, *P. macrospermum*, known only from six collections in South America was not examined. Correlation of its reported characters with results of this study suggest it is conspecific with *P. vaginatum*.

*Pappophorum*, commonly known as pappusgrass, was described by Johann von Schreber in 1791. It is a New World genus of the Pappophoreae and Chloridoideae with taxa in both the northern and southern hemispheres (Renvoize, 1984; Clayton and Renvoize, 1986). Occurring throughout the tropics from semi-desert areas to woodlands typically in dry, sandy soils, it appears to have a disjunct distribution as it has not been reported for the mainland of Central America. It is distributed throughout the Caribbean and throughout South America with the exceptions of Chile, Guyana, Surinam, and French Guiana. In North America, it is known only from Mexico, Arizona, and Texas. During the past 25 to 30 years, several individuals

studied the genus using traditional taxonomic methods of examining specimens in the field and in the herbarium, and estimates of the number of species ranged from 8 to 20. Burkart (1969) cited 12 species for Argentina, while Cabrera (1970) and Nicora (1978) listed 20 for the region. Pensiero (1986), also working in Argentina, listed 10 species as occurring in the tropics and subtropics of which he thought 7 occurred in Argentina. Clayton and Renvoize (1986) recognized a total of 9 species. Most recently, Reeder and Toolin (1989) and Watson and Dallwitz (1992) reported the total number of species to be 8.

Difficulty in circumscribing species in *Pappophorum* appears to be due to their extensive morphological variability and similarity in many features. This has led to differences in taxonomic opinion with numerous species being described. Changes in classification with various combinations of taxa created has led to nomenclatural confusion as well. Both Pensiero (1986) and Reeder and Toolin (1989) acknowledged the difficulty in distinguishing taxa and preparing a key for identification of species that enables its user to identify consistently and correctly individual plants of the genus. In addition, they recognized that their keys did not encompass the full range of morphological variation in the genus. Because no one has attempted to examine simultaneously all species of *Pappophorum* from both hemispheres nor to study them using contemporary systematic/morphometric techniques, this investigation was undertaken. The objectives of this study were: (1) to describe the pattern of morphological variation in the genus, (2) to develop a classification reflecting that pattern of variation, (3) to clarify the nomenclatural history of each taxon, and (4) to provide a key to all species. In this paper, the results of the morphometric analyses and a classification including a key, descriptions of the taxa, and lists of synonyms are presented.

## MATERIALS AND METHODS

In order to examine the morphological variation within and among taxa, 676 herbarium specimens from throughout *Pappophorum*'s distributional range were obtained from ARIZ, BH, F, LP, MO, SI, and US (Appendix E). Specimens from CORD used in Pensiero's 1986 study could not be obtained. Plants were examined using a dissecting microscope and magnifications of 7-30x. Spikelets were removed with permission and when necessary, softened in an aqueous solution of 1% Aerosol OT and 25% methanol (v/v, 1:1). Characteristics or features of the genus and its species were compiled from previous keys and descriptions. Examination of the specimens revealed a number of additional characters that appeared to be useful in distinguishing among the taxa (Table 1). Initially, the specimen on each herbarium sheet was scored for 151 morphological features and treated as an Operational Taxonomic Unit (OTU) (Appendix F). In some instances, more than one taxon was represented on a single herbarium sheet. In such cases, each plant was scored and treated as an OTU.

Fifty-one characters were subsequently used in the numerical analyses (Table 2). These characters were selected because they appeared to vary among groups with the potential to be diagnostic in delimiting taxa. A data matrix (51 characters by 676 OTUs) was generated. Because the characters were a mixture of quantitative and qualitative ones, the collected data were subjected to multivariate analyses using the NT-SYS (Numerical Taxonomy for SYStematics) program of Rohlf (1992). The data were standardized using the STAND program and a matrix of similarity and dissimilarity coefficients was generated with SIMINT (Rohlf, 1992). The UPGMA clustering analysis using SAHN was performed and a phenogram was generated (Appendix G).

Table 1. Characters emphasized in most recent treatments of *Pappophorum* (Pensiero 1986, Reeder & Toolin 1989, Gatti Clark 1997).

Character	Pensiero	Reeder & Toolin	Gatti Clark
1. Height of Plants	+	+	+
2. Glands on Plant - abundance		+	
3. Nodes - glands			+
4. Nodes - indumentum			+
5. Internodes - glands			+
6. Internodes - indumentum			+
7. Sheaths - glands			+
8. Sheath Margins - indumentum			+
9. Blade Surfaces, Adaxial - glands			+
10. Blade Surfaces, Abaxial - glands			+
11. Blade Margins - glands			+
12. Blade Bases - flaring			+
13. Blade Bases - indumentum of flaring			+
14. Inflorescences - width		+	+
15. Inflorescences - length	+	+	
16. Inflorescences - density of florets	+	+	
17. Inflorescences - dense or loose		+	
18. Inflorescences - shape	+		
19. Inflorescences - color/texture		+	
20. Inflorescences - glands		+	
21. Peduncles - glands			+
22. Peduncles - indumentum			+
23. Central Axes - glands		+	+
24. Central Axes - abundance of glands			+
25. Central Axes - indumentum			+
26. Branches - appressed/reflexed	+		
27. Branches - glands		+	
28. Pedicels - glands		+	+
29. Pedicels - abundance of glands			+
30. Pedicels - indumentum			+
31. Spikelets - length	+		
32. Spikelets - width	+		
33. Florets - length			+
34. Florets - number per spikelet	+		
35. Fertile Florets - number	+		
36. Calluses - indumentum		+	+
37. Glumes - length relative to florets			+
38. Glumes - length relative to each other			+
39. Lower Glumes - awns		+	+
40. Lower Glumes - length of awns		+	+

41. Lower Glumes - length of bodies	+		+
42. Lower Glumes - width of bodies			+
43. Lower Glume Bodies - glands			+
44. Lower Glume Awns - glands			+
45. Upper Glumes - awns		+	+
46. Upper Glumes - length of awns		+	+
47. Upper Glumes - length of bodies	+		+
48. Upper Glumes - width of bodies		+	+
49. Upper Glume Bodies - glands			+
50. Upper Glume Awns - glands			+
51. LemmaBodies - length	+	+	+
52. Lemma Bodies - width			+
53. Lemma Bodies - shape		+	
54. Lemma Outer Surfaces - indumentum	+	+	+
55. Lemma Outer Surfaces - glands			+
56. Lemma Inner Surfaces - indumentum	+	+	+
57. Lemma Inner Surfaces - degree of indumentum		+	+
58. Lemma Awns - number	+		+
59. Lemma Awns - length	+	+	+
60. Lemma Awns - reflexed		+	
61. Paleas - enclosed in lemmas		+	+
62. Paleas - shape		+	
63. Paleas - texture		+	
64. Paleas - length	+		+
65. Paleas - width			+
66. Palea Nerves - indumentum		+	+
67. Palea Nerves - glands		+	+
68. Caryopses - length			+
69. Caryopses - width			+

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Table 2. Morphological characters and character states or numerical units used in NT-SYS analyses of species of *Pappophorum*.

Characters	Character States or Units
1. Height of Plants	in cm
2. Nodes - glands	1) present 2) absent
3. Nodes - indumentum	1) glabrous 2) scabrous 3) pubescent 4) puberulent
4. Internodes - glands	1) present 2) absent
5. Internodes - indumentum	1) glabrous 2) scabrous 3) pubescent 4) puberulent 5) pilose
6. Sheaths - glands	1) present 2) absent
7. Sheath Margins - indumentum	1) glabrous 2) scabrous 3) pubescent 4) puberulent 5) pilose 6) pilose & scabrous
8. Blade Surfaces, Adaxial - glands	1) present 2) absent
9. Blade Surfaces, Abaxial - glands	1) present 2) absent
10. Blade Margins - glands	1) present 2) absent
11. Blade Bases - indumentum	1) glabrous 2) pubescent
12. Inflorescences - width	in cm
13. Peduncles - glands	1) present 2) absent
14. Peduncles - indumentum	1) glabrous 2) scabrous 3) pubescent 4) puberulent 5) pilose
15. Central Axes - glands	1) present 2) absent
16. Central Axes - abundance of glands	1) sparse 2) moderately abundant 3) abundant
17. Central Axes - indumentum	1) glabrous 2) scabrous 3) pubescent 4) puberulent 5) scabrous & pubescent
18. Pedicels - glands	1) present 2) absent
19. Pedicels - abundance of glands	1) sparse 2) moderately abundant 3) abundant
20. Pedicels - indumentum	1) glabrous 2) scabrous 3) pubescent 4) puberulent
21. Florets - length of first floret	in mm
22. Calluses - indumentum	1) glabrous 2) less than 1/2 length of floret body 3) greater than 1/2 length of floret body
23. Glumes - length relative to each other	1) equal 2) subequal 3) unequal
24. Glumes - length relative to florets	1) both longer than floret bodies 2) both shorter than floret bodies 3) one longer and one shorter than floret bodies
25. Lower Glumes - awns	1) present 2) absent
26. Lower Glumes - length of awns	in mm
27. Lower Glumes - glands of awns	1) present 2) absent
28. Lower Glumes - length	in mm
29. Lower Glumes - width	in mm
30. Lower Glumes - glands	1) present 2) absent
31. Upper Glumes - awns	1) present 2) absent
32. Upper Glumes - length of awns	in mm
33. Upper Glumes - glands	1) present 2) absent
34. Upper Glumes - length	in mm
35. Upper Glumes - width	in mm
36. Upper Glumes - glands	1) present 2) absent

37. Lemma Awns - length	in mm
38. Lemma Bodies - length	in mm
39. Lemma Bodies - width	in mm
40. Lemmas - glands	1) present 2) absent
41. Lemma Awns- number	
42. Lemma Outer Surfaces - indumentum	1) less than 1/2 length of Lemmas body 2) greater than 1/2 length of Lemmas body 3) continuous from base to apex
43. Lemma Inner Surfaces - indumentum	1) glabrous 2) scabrous 3) pubescent 4) puberulent
44. Lemma Inner Surfaces - indumentum	1) apex only 2) from base to apex, concentrated at apex 3) uniform from base to apex
45. Paleas - enclosed in lemmas	1) present 2) absent
46. Palea Nerves - indumentum	1) glabrous 2) scabrous 3) pubescent 4) puberulent 5) pilose
47. Palea Nerves - glands	1) present 2) absent
48. Paleas - length	in mm
49. Paleas - width	in mm
50. Caryopses - length	in mm
51. Caryopses - width	in mm

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Univariate analyses were conducted to examine the relationships among selected taxa. Using the information generated in these analyses, the pattern of morphological variation in the genus was interpreted and taxonomic decisions made to produce a classification. Species descriptions were generated using DELTA (DEscription Language for TAXonomy; Dallwitz and Paine, 1986).

## RESULTS & DISCUSSION

Delimitation of species boundaries and certainty of identification of individual plants has long frustrated those studying *Pappophorum*. Pensiero (1986) commented on the problems encountered in delimiting taxa and constructing a workable key in the absence of easily observed morphological characters. Reeder and Toolin (1989) likewise noted the difficulty in circumscribing species in the genus. Because the species are so similar and some have individuals that deviate in one or two conspicuous characters to superficially resemble another taxon, the pattern of morphological variation in *Pappophorum* is indeed complex and the problems faced by my predecessors is understandable. However, I believe that the pattern becomes clearer when many characters are examined simultaneously via multivariate analysis, and specimens are examined critically for: (1) the presence, abundance, and distribution of glands; and (2) the presence and nature of indumentation on the adaxial or inner surface of the lemmas. Pensiero (1986) used this indumentation character in his study of the Argentinian species. Reeder and Toolin (1989) used both indumentation and the presence of glands in the inflorescence. I found that examination of the culms and leaves for glands to be significantly useful as well.



On the basis of the multivariate analyses conducted in this study, *Pappophorum* comprises seven groups (Figure 1; Appendix G). Five of the groups correspond to previously recognized species. They are: *P. bicolor*, *P. hassleri*, *P. krapovickasii*, *P. pappiferum*, and *P. philippianum*. These findings are consistent with previous workers who recognized these taxa as distinct and had little trouble identifying individuals belonging to them. A sixth group corresponds to *P. mucronulatum*, also traditionally recognized as a distinct taxon, but as discussed below, circumscribed in several different ways. The seventh group consists of individuals previously identified as *P. vaginatum*, *P. caespitosum*, and *P. subbulbosum*. Salient points of the biology and taxonomy of each species or group are summarized in the following paragraphs.

#### ***Pappophorum bicolor* Fourn. 1886**

*Pappophorum bicolor* was described by Eugene Pierre Nicolas Fournier in 1886. The binomial was actually published one year earlier by William Botting Hemsley but was a *nomen nudum*. Native to North America, it is distributed in the southwestern United States and Mexico. Its morphological distinctiveness is due to the presence of glands on culms and leaves as well as within the inflorescence. The awns and apex of the lemma body are typically purple in color. Morphologically, *P. bicolor* is most similar to *P. mucronulatum*, but can be distinguished from it by differences in the width of the panicle and the lemma awn to body ratio. In *P. bicolor*, the panicles are typically 0.8-2 cm wide and the lemma awns are 0.6-1.8 times longer than the lemma bodies; in contrast, *P. mucronulatum* has panicles that are 2-7cm wide and the lemma awns are 2-4.5 times longer than the lemma bodies. Occasional individuals of *P. bicolor* exhibit unusually wide panicles and thus

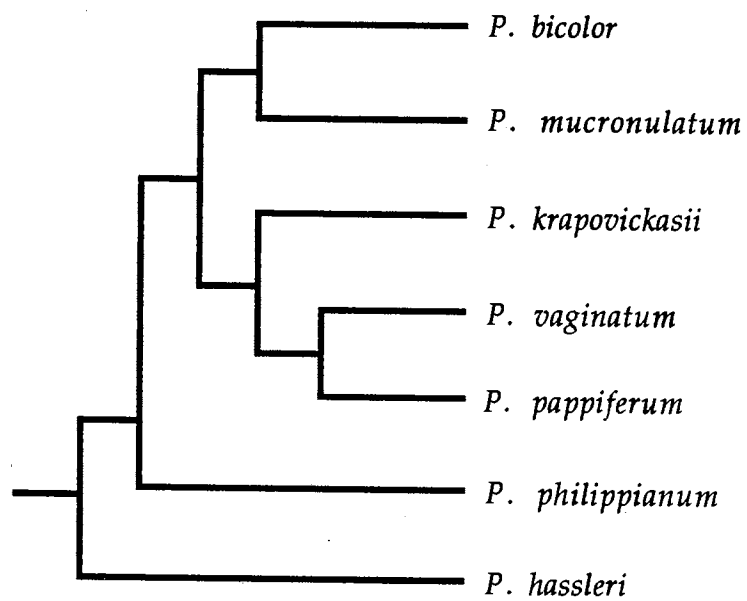


Figure 1. Simplification of phenogram (Appendix G) showing 7 groups of *Pappophorum*.

at first glance may be mistaken for *P. mucronulatum*. All other features, however, are constant and careful examination of them allows proper identification of these exceptional individuals. Likewise, occasional plants of *P. mucronulatum* have narrower panicles.

Renvoize's (1984) decision to list *P. bicolor* as a synonym of *P. vaginatum* was due to the confusion surrounding the type specimens of *P. vaginatum* (see discussion of *P. vaginatum*). *P. bicolor* is morphologically quite distinct from *P. vaginatum* and the two can be separated by the presence of glands on the culms and leaves of *P. bicolor* and their absence on *P. vaginatum*.

#### ***Pappophorum hassleri* Hackel 1904**

Described in 1904 by Edward Hackel, the most striking feature of *P. hassleri* is the conspicuous crateriform glands found throughout the plants. Pensiero (1986) commented on the size of the spikelets and the deep violet color of the florets as a distinguishing character of this taxon, in addition to the glands. Found only in Paraguay, only two specimens *Hassler* 9527 (US #899535) and *Hassler* 12089 (US #726079) were examined and more are needed to address the full range of variation exhibited by the species. Pensiero's comments, however, appear to be accurate.

#### ***Pappophorum krapovickasii* Roseng. 1975**

Originally described from Paraguay in 1975 by Bernardo Rosengurtt, *P. krapovickasii* occurs in Argentina, Bolivia, Brazil, Colombia, Uruguay, and Venezuela as well. It is morphologically quite variable and exhibits a wide range of floret sizes, glume lengths, and indumentation lengths. Because of this variation, some individuals at first sight resemble plants of *P. vaginatum* and *P. philippianum*. Likewise, in the numerical analyses, some plants of *P.*

*krapovickasii* clustered with these taxa. It is most often confused with *P. vaginatum* because of their similarities in floret size and the length of the indumentation on the outer surfaces of the lemmas; but can be distinguished by the puberulent, or rarely pubescent, inner or adaxial surface of its lemmas. The inner surfaces of the lemmas of *P. vaginatum*, in contrast, are glabrous or scabrous. In addition, it can possess large, sometimes crateriform glands. Glands are always absent in *P. vaginatum*. The length of the indumentum of the calluses and the abaxial surface of the lemmas can be used to distinguish *P. krapovickasii* from *P. philippianum*, the latter has longer hairs.

### ***Pappophorum macrospermum***

Bernado Rosengurtt, Blanca Renee Arrillaga Oronoz de Maffei, and Primavera Izaguirre de Arturio described *P. macrospermum* from Uruguay in 1970. They cite only four specimens, and is apparently rare in Uruguay, Brazil, and Argentina. Pensiero (1986) examined a paratype and two additional specimens. In this study, no specimens were encountered that were identifiable as *P. macrospermum*. Likewise, Reeder and Toolin did not encounter specimens of the species.

Given the characteristics described by Pensiero's (1986; personal communication), I believe *P. macrospermum* is most likely to be conspecific with *P. vaginatum*. It lacks glands, its lemmas have scabrous inner surfaces and short indumentation on the outer surfaces; attributes in common with *P. vaginatum*. The lengths of the spikelets and glumes, however, are troublesome; they are longer than those of most individuals of *P. vaginatum*. It may be that these individuals are atypical or represent plants at one end of the range of variation of *P. vaginatum*. In contrast, Reeder and Toolin (1989) proposed that *P. macrospermum* was only a variant of *P. philippianum*. I

believe this interpretation to be questionable, because *P. philippianum* has lemmas with inner surfaces that are pubescent to puberulent. Likewise, other species of *Pappophorum* with which it might be considered to be conspecific can be eliminated, e.g., *P. mucronulatum* has glands on the culms and leaves and *P. krapovickasii* has lemmas with inner surfaces that are puberulent to pubescent. Thus, in the absence of specimens to examine, *P. macrospermum* is here combined with *P. vaginatum*.

***Pappophorum mucronulatum* Nees 1829**

Described by Christian Gottfried Daniel Nees von Esenbeck in 1829, *P. mucronulatum* is found in Brazil, Colombia, Venezuela, and on the Islas de la Bahia of Honduras. Contrary to earlier reports (Hitchcock, 1935, 1950), it does not occur in North America. It is a morphologically variable taxon characterized by glands on the culms and leaves, lemmas that are glabrous or scabrous on the inner surface, wide panicles, and lemmas with long awns. It comprises two almost distinct groups that perhaps warrant recognition as varieties (Appendix G). Individuals of the two groups differ in the abundance and distribution of the glands, and in the size of their glumes. However, the range of variation exhibited by the other characters of the species is continuous, and the differences in glands and glumes do not justify separation into two taxa.

This distinctive, bimodal pattern of variation most likely has contributed to the taxonomic confusion surrounding the circumscription of *P. mucronulatum* and its relationship to other species of the genus. The taxonomic history of the species is well documented by Reeder & Toolin (1989). In the following paragraphs, their points are expanded in the context of the results of this study. A.S. Hitchcock (1927, 1935, 1950) was the first to

merge *P. mucronulatum* with another species; he combined it with *P. vaginatum*. Although normally having rather open panicles, some plants of *P. mucronulatum* have narrow, spicate panicles resembling those of *P. vaginatum* and this may be the reason he combined the two species. In contrast, Gould (1975) maintained the two taxa as distinct, emphasized the difference in their geographical distribution with *P. mucronulatum* in South America and *P. vaginatum* in North America, and cited Rosengurtt as indicating that *P. mucronulatum* was restricted to South America. Rosengurtt in a letter to Reeder (discussed in Reeder & Toolin, 1989) suggested that the presence of glands in the inflorescence could be used to distinguish the two species. The importance of glands was confirmed in this study. *P. mucronulatum* has glands on the culms and leaves while *P. vaginatum* does not. In addition, *P. mucronulatum* is strictly South American and apparently restricted to the countries listed above. No North American specimens were encountered in this study; Reeder and Toolin likewise did not find any North American specimens of the species.

Rosengurtt (ibid.) also suggested that *P. mucronulatum* was closely related to *P. pappiferum*. This belief may have been based on the superficial similarity of the inflorescences. Both have somewhat open panicles with a "soft" appearance. However, the two species differ in the presence of glands on the culms and leaves; *P. pappiferum* does not have them. Reeder and Toolin also noted this difference. A more subtle difference is the difference in the "soft" nature of the panicles. *P. pappiferum* has a silky feel to the touch. The awns are flexuous, bend like hairs, and tend to hide the spikelets. In contrast, the awns of *P. mucronulatum* are stiffer, do not bend easily, and the spikelets are more visible.

As noted in my discussion of *P. bicolor*, occasional individuals of *P. mucronulatum* have narrower panicles and those of *P. bicolor* have wider ones. In the absence of careful examination of the other characters of the plants, especially the awn length relative to the lemma body length, mistakes in identification can occur. Such misidentified herbarium specimens were encountered and probably are the basis for the misconception that *P. mucronulatum* also occurs in North America.

Finally, *P. mucronulatum* has been considered by Burkart (1969) and Cabrera (1970) to be conspecific with *P. subbulbosum*, a taxon I believe to be conspecific with *P. vaginatum*, as discussed below. Regardless of the taxonomic status of *P. subbulbosum*, the presence of glands on the culms and leaves serves to distinguish the two taxa; *P. subbulbosum* lacks glands. Nicora (1978) and Renvoize (1984) also employed nerve number of the lemmas to separate the two taxa; five for *P. mucronulatum* and seven for *P. subbulbosum*. However, both Pensiero (1986) and Reeder and Toolin (1989) reported *P. subbulbosum* to occasionally have five. Nerve number was not included in the analyses of this study because of the infraspecific variation it exhibited in all species.

### ***Pappophorum pappiferum* (Lamark) Kuntze 1898**

*Saccharum pappiferum* was described by Jean Baptiste Antoine Pierre Monnet de Lamark in 1791. In 1898, Carl Ernst Otto Kuntze transferred it to *Pappophorum*. It is found throughout most of South America: Argentina, Bolivia, Brazil, Colombia, Ecuador, Paraguay, Peru, and Venezuela. In addition, it is found throughout the Caribbean, including Cuba, Puerto Rico and Trinidad; in North America, it is known only from Mexico. Characterized by its silky inflorescence and lack of glands throughout, *P.*

*pappiferum* is readily distinguished from other species in the genus. The panicle is typically open, but some plants can have a very narrow, spicate form (cf Fig. 2 in Pensiero, 1986). When narrow, they may be erroneously identified as other members of the genus. In contrast to the other species, *P. pappiferum* is relatively homogeneous in terms of morphology. Individuals clustered at high correlation levels (Appendix G).

### ***Pappophorum philippianum* Parodi 1943**

Lorenzo Raimundo Parodi described *P. philippianum* in 1943. It is distributed in both South and North America. In the south, it occurs in Argentina, Bolivia, Brazil, and Paraguay, while in the north, it is known only from Sonora, Mexico (Reeder and Toolin, 1988) and Texas (Gatti Clark, 1997). This taxon is noted for its long callus hairs which are  $2/3$  to  $3/4$  the length of the lemma bodies and for the long hairs on the outer surfaces of the lemmas. In addition to these conspicuous, distinguishing features, the inner surfaces of the lemmas are pubescent to puberulent. Glands may be present or absent.

As noted above, some individuals of *P. krapovickasii* with large florets and longer glumes resemble *P. philippianum*. Close inspection, however, of the length of the indumentation of the callus and the outer surface of the lemmas permits consistent identification. The callus indumentation of *P. philippianum* is always  $2/3$ - $3/4$  the length of the lemmas and the outer surfaces always have long, spreading hairs. In contrast, the callus indumentum of *P. krapovickasii* is less than  $1/2$  the length of the lemma and the outer surface has short, appressed hairs. Although some specimens of *P. krapovickasii* were observed with longer lemma body hairs, the callus hair length was sufficient to distinguish them from *P. philippianum*.



***Pappophorum vaginatum* Buckley 1866**

*Pappophorum vaginatum* was described by Samuel Botsford Buckley in 1866, and, like *P. mucronulatum*, has perplexed taxonomists for decades. As discussed above, it was combined with *P. mucronulatum* by Hitchcock (1927) possibly because some plants of *P. mucronulatum* have narrow spicate panicles resembling those that *P. vaginatum* produces. The presence of glands on the culms and leaves of *P. mucronulatum* and their absence in *P. vaginatum*, however, can be used to reliably distinguish the two species.

The type is a collection by C.W. Wright #803 from Texas, USA and originally labeled *Pappophorum apertum* Munro. It is a mixture of plants of *P. vaginatum* and *P. bicolor*; this is most likely due to Asa Gray's practice of distributing Wright's specimens collected at different times and localities as a single distribution number if he thought they were the same species (Shaw, 1987). The Wright #803 collections I examined consisted of two complete plants and one inflorescence. One plant and the inflorescence (MO #2975955) are *P. bicolor*. The panicles of both have glands and the complete plant also has them on the culms and leaves. The awns and distal portion of the lemmas have a dark color that is consistent with the purple coloring characteristic of *P. bicolor*. In the multivariate analyses conducted in this study, both the plant and the inflorescence cluster with other individuals of *P. bicolor*. The other complete plant (MO #2975956) is *P. vaginatum*. It lacks glands throughout and has light colored awns and lemmas which is consistent with the concept of the species held by those studying the genus, including myself. In the multivariate analyses, it clustered with other individuals of *P. vaginatum*.

My observations and interpretation are in agreement with those of Renvoize and Reeder (personal communications). Renvoize has confirmed

that the *Wright* #803 collections at Kew are *P. bicolor*. Reeder's examination of the collections deposited in the Gray Herbarium, which I did not see, revealed them to be a mixture of the two species. Rosengurtt, likewise, annotated the Gray Herbarium collections as *P. vaginatum* and *P. bicolor*.

*P. subbulbosum* is a third species that has been merged with *P. vaginatum*. Described in 1896 by J. Arechavaleta from Uruguay, *P. subbulbosum* has been recognized both as a distinct species (Swallen, 1964; Pensiero, 1986; Beetle, 1987) and as conspecific with *P. mucronulatum* (Burkart, 1969; Cabrera, 1970). Reeder and Toolin (1986) contended that it was conspecific with *P. vaginatum* because specimens from Argentina were essentially identical to those from the United States and Mexico with respect to the lengths of the inflorescence, lower and upper glumes, and lemma bodies and awns.

Another taxonomic interpretation of the circumscription of *P. vaginatum* and its relationship to other species in the genus is offered in this study. On the basis of the univariate and multivariate analyses conducted, it is believed that the species occurs in both North and South America and comprises taxa recognized by earlier workers as *P. vaginatum*, *P. caespitosum*, and *P. subbulbosum*. Specimens identified as these species form a distinct group. As can be seen in Figure 2, the group is morphologically relatively homogeneous with OTUs of the three taxa intermixed and clustering together at high correlation levels. Univariate analyses of the 51 characters of each taxon are congruent (Figure 3). This merging of the three species into one group in the analysis confirmed my observations during the initial sorting and identification of the specimens that the three were not morphologically discrete. Reeder and Toolin's (1989) decision to treat *P. subbulbosum* as

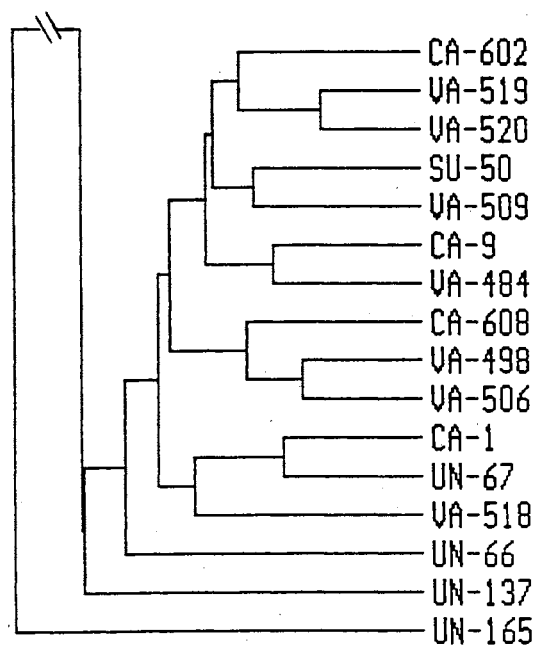


Figure 2. Portions of phenogram (Appendix G) with OTUs labeled showing clustering of *P. vaginatum* (VA), *P. caespitosum* (CA), and *P. subbulbosum* (SU, UN).

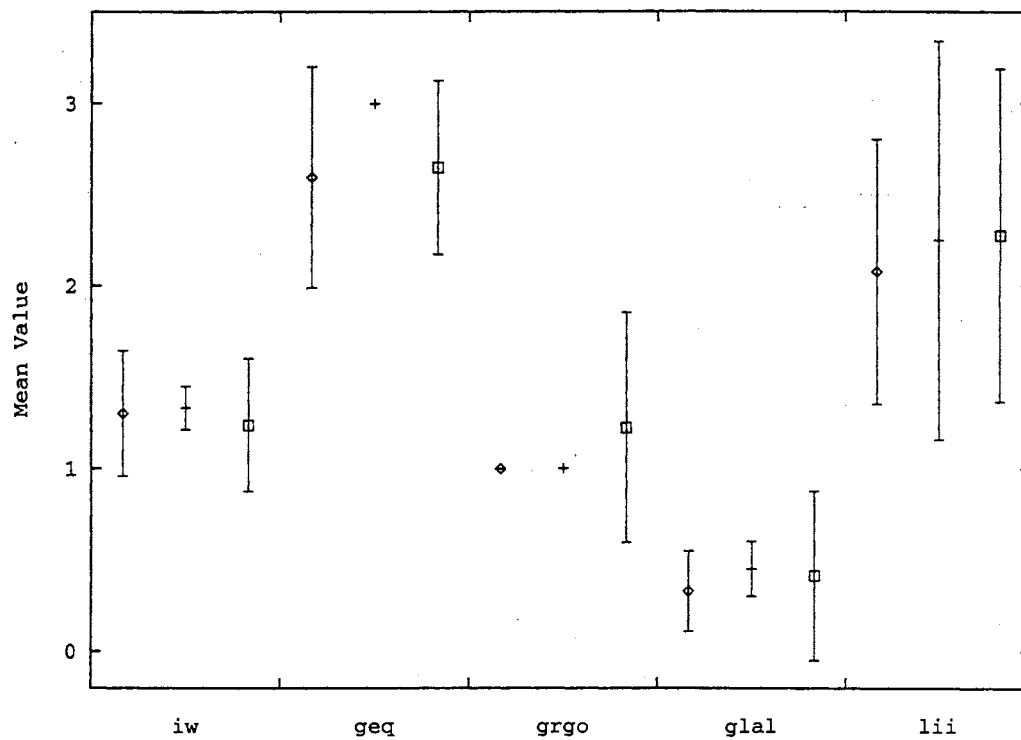


Figure 3. Univariate analysis of *P. vaginatum* (diamond), *P. caespitosum*, (square) and *P. subbulbosum* (cross). Means and standard deviations for 5 traits are shown: iw=inflorescence width; geq=glume length relative to each other; grgo=glume length relative to florets; glal=lower glume awn length; lii=indumentation of inner surface of lemmas.

conspecific with *P. vaginatum* and Pensiero's (1986) comments about the similarity of *P. subbulbosum* and *P. caespitosum* support this conclusion.

As noted in my discussion of the morphological variability of *P. krapovickasii*, some individuals because of their smaller floret size and longer indumentation of the outer surface of the lemmas resemble *P. vaginatum*. Distinguishing between the two species is accomplished by examining the inner surface of the lemmas. The inner surface of *P. vaginatum* is glabrous or scabrous, while the inner surface of *P. krapovickasii* is puberulent to pubescent. A second feature that can be used is the absence or presence of glands. They are always absent in *P. vaginatum*, while *P. krapovickasii* sometimes has them.

## TAXONOMY OF *PAPPOPHORUM*

### **PAPPOPHORUM** Schreber

Schreber, Gen. Plant. 2: 787. 1791

*Enneapogon* Desv. ex Beauv. Agrost. 81. 1812; et Journ. Bot. 3:70. 1814

*Euraphis* Trin. ex Lindl. Veg. Kingd. 1:15. 1847

*Polyraphis* Lindl. Veg. Kingd. 115. 1847

**Plants** perennial; caespitose. **Culms** (6-) 20-80 (-200) cm tall; erect. **Nodes** constricted to swollen; stramineous to purple; glands present or absent. **Internodes** solid; glands present or absent. **Sheaths** usually longer than internodes; indumentum glabrous to pilose, sometimes arising from tubercles, margins glabrous to pilose, glands present or absent. **Ligules** ciliate, 1 or 2 sets of different lengths. **Auricles** absent. **Collars** not constricted, indumentum glabrous to pilose. **Blades** appressed or ascending, narrow, generally less than 10 mm wide. Adaxial surfaces of blades glabrous to pilose, sometimes arising from tubercles, glands present or absent. Abaxial surfaces glabrous to pilose, sometimes arising from tubercles, glands present or absent. Margins of blades indumentum glabrous to pilose often scabrous, sometimes arising from tubercles, glands present or absent. Bases of blades usually flared, indumentum often pubescent. **Inflorescences** of panicles, terminal, remaining attached to plant at maturity, bearing perfect spikelets, stramineous or purplish at maturity, densely contracted or spicate to open, erect, oblong to trullate, 0.5-10 cm wide. **Peduncles** inserted or not inserted in sheath, indumentum glabrous to pilose usually glabrous, glands present or absent. **Central axes** terminating in a spikelet, straight, capillary to stout, up to 1.25 mm wide, indumentum glabrous to puberulent usually scabrous, glands present or absent. **Branches** 1 per node, appressed, 1-7 cm long, indumentum usually scabrous, glands present or absent. **Pedicels** 1 per node, appressed or usually reflexed at spikelet maturity, indumentum glabrous or most often scabrous, glands present or absent. **Spikelets** compression lateral, stramineous to purple, 0.8-3 mm wide, 6-12 mm long. Florets (3) 4-6 (7), oblong to elliptic, 6-12 mm long, similar to one another. **Fertile florets** present, 1-4 (5), perfect, below the sterile florets. **Sterile florets** present, 2-4, functionally staminate or neuter, above the fertile florets. **Callus** indumentum usually less than 1/2 the length of the floret body, greater in *P. philippianum*, indumentum usually dense. **Glumes** present, free. **Lower glumes** membranous, smooth, keeled, indumentum often scabrous, glands present or absent, glands on midnerve or rarely on back, nerves 1, midnerves indumentum often scabrous, apices bifid, or erose, awn present or absent, straight, indumentum glabrous or often scabrous, glands absent or rarely absent. **Upper glumes** membranous, smooth, keeled, indumentum often

scabrous, glands present or absent, glands on midnerve or rarely on back, nerves 1, midnerves indumentum often scabrous, apices bifid, or erose, awn present or absent, straight, indumentum glabrous or often scabrous, glands absent or rarely absent. *Lemmas* all alike, coriaceous, oblong to rounded, indumentum of outer surfaces glabrous to pilose, indumentum of inner surfaces glabrous to puberulent. Nerves (5) 7-9 (11), extending to apex. Awns present, generally 12-26, persistent, straight to spreading, generally slender and somewhat fragile, stramineous to purple, indumentum often scabrous, glands absent or rarely present (in *P. hassleri*). *Paleas* often absent in rudimentary sterile florets, texture to subtending lemmas, coriaceous, 2-keeled, indumentum usually glabrous, apices erose. Nerves 2, prominent, indumentum glabrous to puberulent most often scabrous, sometimes arising from tubercles, glands present or absent. Awns present or absent, 1-3. Rachillas hidden by florets, terminating in a rudimentary floret usually appearing as a brush-like appendage. Disarticulation above the glumes, the florets not separating and falling as a unit. *Anthems* oblong, yellow to purple. *Stigmas* brown to purple or white. *Caryopses* concealed by lemmas and paleas at maturity, not falling free from florets, plano-convex, oblong to elliptic, golden-yellow to reddish-brown, smooth.

Base chromosome number 10. Somatic chromosome numbers 30, 40, 50, 60, and 100. Flowering in June-November in the northern hemisphere and October-March in the southern hemisphere. It is found in southwestern USA, Mexico, and most of South America on arid, disturbed sites in grasslands or brushlands often on sandy or alluvial soils. Reported as a primary component of arid prairies and pastures in Argentina.

Key to Species of *Pappophorum*

1. Glands present on culms and leaves.
  2. Inner surfaces of lemmas puberulent to pubescent.
    3. Outer surfaces of lemmas with long, spreading hairs; Indumentum of callus 2/3-3/4 the length of lemma. .... *P. philippianum*
    3. Outer surfaces of lemmas with short, appressed hairs; Indumentum of callus less than 1/2 the length of lemma. .... *P. krapovickasii*
  2. Inner surfaces of lemmas glabrous to scabrous.
    4. Glands present on outer surfaces of lemmas and lemma awns. .... *P. hassleri*
    4. Glands absent on outer surfaces of lemmas and lemma awns.
      5. Panicles 0.8-2 cm wide.
        6. Lemma awns 0.6-1.8 times longer than lemmas. .... *P. bicolor*
        6. Lemma awns 2-4.5 times longer than lemmas [exceptional individuals]. .... *P. mucronulatum*
      5. Panicles 2-7 cm wide.
        7. Lemma awns 0.6-1.8 times longer than lemmas [exceptional individuals]. .... *P. bicolor*
        7. Lemma awns 2-4.5 times longer than lemmas. .... *P. mucronulatum*
  1. Glands absent on culms and leaves.



8. Inner surfaces of lemmas puberulent to pubescent.
  9. Outer surfaces of lemmas with long, spreading hairs; indumentum of callus 2/3-3/4 the length of lemma. .... *P. philippianum*
  9. Outer surfaces of lemmas with short, appressed hairs; indumentum of callus less than 1/2 the length of lemma. .... *P. krapovickasii*
8. Inner surfaces of lemmas glabrous to scabrous.
  10. Inflorescences open, spreading panicles, 3-10 cm wide; lower branches generally spreading exposing the central axes. .... *P. pappiferum*
  10. Inflorescences narrow, contracted panicles, 0.5-2.5 cm wide; lower branches appressed, hiding central axes.
    11. Panicles appearing silky; floret bodies hidden by lemma awns. .... *P. pappiferum*
    11. Panicles not appearing silky; floret bodies visible among lemma awns. .... *P. vaginatum*

### Species Descriptions

#### ***Pappophorum bicolor* E. Fourn.**

Mexic. Pl. 3:133, 1886. - Mexico.

*Pappophorum bicolor* Fourn. ex Hemsley., Biol. Cent.-Amer. Bot. 3: 568, 1885 - *nom. nud.* - (Mexico)

Specimens Examined. MEXICO. Johnston *et al.* 11625 (MO); Itie 108994 (MO).

Coahuila. Marroquin 3398 (MO); Harvey 1240 (MO); Harvey 939 (MO); Wynd & Mueller 203 (MO); Johnston 8885 (MO); Reeder *et al.* 3278 (ARIZ); Reeder & Reeder 3939 (ARIZ); Reeder & Reeder 3917 (ARIZ). San Luis. Pohl 12464 (MO). Tamaulipas. Diaz 111 (MO). USA. Texas. Clover 1402 (ARIZ); Palmer 33848 (MO); Hitchcock *s.n.* (BH); Hitchcock 448 (MO); Buckley 1883 (BH); Palmer 14488 (MO); Orcuff 5722 (MO); Jones 2635 (MO); Harvey 896 (MO); Shreve 8386 (ARIZ); Van Devender & Toolin 1824 (ARIZ); Orcuff 6091 (MO); Palmer 10214 (MO);

Garza, Jr. 023B (ARIZ); Correll & Wasshausen 27728 (MO); Tracy 8905 (BH); Pohl & Davidse 11800 (MO); Eggert s.n. (MO); Wright 803 (MO); Tharp s.n. (MO).

**Culms** 28-88 cm tall. **Nodes** constricted; purple; indumentum glabrous or scabrous; glands present or absent (usually present). **Internodes** indumentum glabrous; glands present or absent. **Sheaths** margins indumentum glabrous or scabrous; glands present or absent. **Ligules** 1-3.5 mm long. **Collars** constricted; stramineous to purple; indumentum glabrous. **Blades** 2-4.5 mm wide; 12-37 cm long. **Adaxial surfaces** indumentum scabrous; glands absent. **Abaxial surfaces** indumentum glabrous; glands present or absent. **Margins** indumentum scabrous; glands absent. **Bases of blades** flared; indumentum pubescent, or rarely glabrous. **Panicles** purplish; densely contracted; erect; ovate to oblong to lanceolate; 0.8-2 cm wide; (8) 13-22 cm long. **Peduncles** 12-32 cm long; not intersted in sheath; glands present, moderately abundant to abundant. **Central axes** slender; 0.75 mm wide; indumentum scabrous; glands present or rarely absent, sparse to abundant. **Branches** appressed; capillary to slender; 0.3-1 mm wide; 12-43 cm long; indumentum scabrous to glabrous; glands present, sparse to moderately abundant. **Pedicels** capillary; 0.2-0.3 mm wide; indumentum scabrous to glabrous; glands present or rarely absent, sparse to abundant. **Spikelets** 1.5-2.5 mm wide; 6.2-8.5 mm long. **Florets** 4-6; oblong to elliptic; lowest or first floret 6-8 mm long. **Fertile florets** 2 to 4. **Sterile florets** 2 to 3. **Callus** indumentum less than 1/2 the length of the floret body. **Glumes** unequal to subequal; one shorter than the florets and one longer than the florets or both longer than the florets and partially hiding them. **Lower glumes** 3-4.5 mm long; 1-2 mm wide; ovate; glands present or rarely absent, on midnerve only; midnerves indumentum scabrous; apices bifid to erose, awns present rarely absent; 0.1-0.6 mm long; glands absent. **Upper glumes** 3.5-5 mm long; 1-2.5 mm wide; ovate; glands present or rarely absent, on midnerve only, midnerves indumentum glabrous or scabrous; apices bifid; awns present or rarely absent, 0.1-0.5 mm long, glands absent. **Lemmas** bodies usually purple at apex; oblong; 2-4 mm long; 1.8-2.5 mm wide; indumentum of outer surfaces pubescent; indumentum of inner surfaces glabrous or scabrous, restricted to apex. **Awns** (6) 12-19; 2.2-5 mm long; capillary to slender; purple. **Paleas** enclosed completely by lemmas; ovate to elliptic; 2.7-4.5 mm long; 0.7-1.5 mm wide; indumentum glabrous. **Nerves** indumentum scabrous; glands absent or rarely present. **Awns** present; 1 to 3, often dissected so as to appear that there are 5 awns). **Anthers** 0.5-0.8 mm long; yellow. **Stigmas** purple. **Caryopses** ovate to elliptic, or oblong; yellowish-brown to brown, or reddish-brown; 0.3-2.3 mm long; 0.2-0.8 mm in diameter. Found in Texas, USA and Mexico.

***Pappophorum hassleri* Hack.**

Bull. Herb. Boissier. ser. II, 4(3): 280. 1904. - Paraguay

Specimens Examined. PARAGUAY. Hassler 9527 (US); Hassler 12089 (US).

**Culms** 53 cm tall. **Nodes** constricted; purple; indumentum glabrous; glands present, moderately abundant to abundant. **Internodes** indumentum glabrous; glands present, moderately abundant to abundant. **Sheaths** indumentum glabrous; margins glabrous; glands present. **Ligules** 0.5 mm long. **Collars** constricted or not constricted; stramineous; indumentum glabrous. **Blades** 3-4.2 mm wide; 15-20 cm long. **Adaxial surfaces** indumentum scabrous; glands absent. **Abaxial surfaces** indumentum glabrous; glands present or absent. **Margins** indumentum scabrous; glands present, moderately abundant. **Bases of blades** flared; indumentum glabrous. **Panicles** purplish; loosely contracted to densely contracted; erect; lanceolate; 2 cm wide; 10-13 cm long. **Peduncles** 11-13 cm long; glands present, moderately abundant to abundant. **Central axes** stout; 0.8 mm wide; indumentum scabrous; glands present, abundant. **Branches** appressed; slender; 0.6 mm wide; 2.5 cm long; indumentum glabrous to scabrous; glands present, moderately abundant to abundant. **Pedicels** appressed or reflexed at spikelet maturity; slender; 0.4 mm wide; indumentum glabrous to scabrous; glands present, abundant. **Spikelets** 2.7-3.5 mm wide; 16-17 mm long. **Florets** 5-6; oblong; lowest or first floret 10-14 mm long. **Fertile florets** 3. **Sterile florets** 2 to 3. **Callus** indumentum less than 1/2 the length of the floret body. **Glumes** subequal; longer than the florets and partially hiding them. **Lower glumes** 7.2-7.8 mm long; 2.5 mm wide; lanceolate to ovate; glands present, on midnerve and body, abundant; midnerves indumentum scabrous or glabrous; apices entire or bifid; awns present, 0.7-1 mm long, glands absent. **Upper glumes** 8.5 mm long; 2-3 mm wide; lanceolate to ovate; glands present, on midnerve and body, abundant; midnerves indumentum scabrous or glabrous; apices bifid; awns present, 0.8-1.8 mm long; glands present. **Lemmas** oblong; 3.5-4.5 mm long; 3-3.5 mm wide; indumentum of outer surfaces pubescent; indumentum of inner surfaces glabrous. **Awns** 12-19; 9.2-11 mm long; slender; purple; glands present. **Paleas** enclosed partially by lemmas; ovate; 5 mm long; 2.2-2.5 mm wide; indumentum pilose. **Nerves** indumentum scabrous; glands present. **Awns** present; 2. **Anthers** yellow. **Stigmas** brown. **Caryopses** ovate to elliptic; brown; 1.75 mm long; 0.6-0.8 mm in diameter. Found only in Paraguay. Glands are raised and conspicuous throughout the plant.

***Pappophorum krapovickasii* Roseng.**

Comun. Bot. Mus. Hist. Nat. Montevideo 4(58): 1-5. 1975. - Paraguay, Argentina, Venezuela.

Specimens Examined. LOCALITY UNKNOWN. Collector unknown 91 (LP).

ARGENTINA. Venturi 1980 (US); Gaurello 221 (LP); Meyer 12603 (US); Parodi 14618 (US). **Buenos Aires.** Dawson 3234 (LP); Cabrera 8137 (LP); Cabrera 8046 (LP); O'Boelcke et al. 1528 (LP); O'Boelcke et al. 1543 (LP); O'Boelcke et al. 12582 (MO); Ricci 327 (LP). **Catamarca.** Job 1307 (LP); Sayago 1520 (SI); Reales 1971 (US); Briguella 279 (LP); Parodi 14358 (LP); Schreiter 45666. (US). **Chaco.** Schulz 10651 (F); Schulz 914 (US). **Cordoba.** Stuckart 135 (LP); Bridarolli 1220 (LP); Castellanos 89 (US); Castellanos 113 (SI); Spegazzini s.n. (LP); Rosengurt B-7617 (US); Burkart 10139 (SI). **Corrientes.** Quarín 2341 (SI); Pedersen 3722 (US); Renvoize et al. 3608 (MO); Renvoize et al. 3571 (MO). **Formosa.** Budin 13347 (US); Parodi 8459 (US). **Jujuy.** Fabris & Crisci 6831 (LP); Parodi 14618 (LP); Cabrera 15056 (LP); Cabrera 15079 (LP); Collector unknown 5339 (LP); Cabrera et al. 26852 (LP); Cabrera et al. 18456 (LP); Cabrera 12073 (LP). **La Pampa.** Burkart 15825 (SI); Itrie 2 (US); Bacigalupo 20633 (US). **La Rioja.** Kurtz 14378 (LP); Biraben & Biraben 967 (LP). **Mendoza.** Covas 940 (SI); Leal 7322 (LP); Dawson 3243 (LP); Leal 17188 (ARIZ); Burkart et al. 13875b (SI). **Rio Negro.** Fischer 43 (BH). **Salta.** Correa et al. 4309 (SI); Alfredo 171 (F); Toledo 1175 (MO); Cabrera 8823 (LP); Nicora et al. 9157 (SI). **San Luis.** Bruzzone 1222 (LP); Guirrazzi 53 (LP). **San Juan.** Cabrera 24370 (LP). **Santiago del Estero.** Bartlett 19743 (US); Bruzzone 1598 (LP); Schulz 1339 (US). **Santa Fe.** Bissio 624 (LP). **Tucuman.** Rodriguez 248 (US); Schreiter 4497 (US); Luna 696 (US); Venturi 1068 (US); Stuckert 21591 (MO). **BOLIVIA.** Eyerdam 24877 (F). **Cochabamba.** Solomon & King 15904 (MO). **San Pedro.** Cardenas 3917 (US); Culter & Cardenas 10016 (US). **Santa Cruz.** Killeen 1729 (F); Killeen 1520 (ARIZ, F, MO). **Tarija.** Fries 1099 (US). **BRAZIL.** Chase 7767 (MO, US); Chase 7872 (US). **Bahia.** Allem et al. 2266 (MO); Sabzmann s.n. (US). **COLOMBIA.** Saravia 2915 (US). **PARAGUAY.** Asuncion. Hartley & Rojas SH190 (US). **Chaco.** Anderson 1174 (US). **Nueva Asuncion.** Brunner 1674 (MO). **Jardin.** Archer 4940 (US). **URUGUAY.** Capurro. Herter 540 (MO). **Paysandu.** Rosengurt B-3238 (US). **Rio Negro.** Rosengurt B-6720 (US). **VENEZUELA.** Vela De Coro. Curran & Haman 448 (BH).

**Culms** 29-130 cm tall. **Nodes** constricted; indumentum glabrous; glands absent. **Internodes** indumentum glabrous or scabrous; glands absent. **Sheaths** margins indumentum glabrous or scabrous; glands absent. **Ligules** 0.6-1.25 mm long. **Collars** constricted; stramineous or rarely purple; indumentum glabrous. **Blades** 1.5-4 mm wide; 7.5-34 cm long. **Adaxial surfaces** indumentum scabrous or scabrous and pilose; glands absent. **Abaxial surfaces** indumentum glabrous or pilose; glands absent. **Margins** indumentum scabrous; glands absent. **Bases of blades** flared; indumentum pubescent or glabrous. **Panicles** stramineous to purplish; loosely contracted to densely contracted; erect; ovate to oblong to lanceolate; 1.4-2.5 cm wide; 12-39 cm long. **Peduncles** 4.5-20 cm long (36); usually inserted in sheath; indumentum glabrous to scabrous; glands absent or rarely present. **Central axes** slender to stout; 0.5-1 mm wide; indumentum scabrous; glands absent. **Branches** appressed; slender; 0.3-0.6 mm wide; 16-25 cm long; indumentum scabrous; glands absent. **Pedicels** capillary; 0.2-0.3 mm wide; indumentum scabrous; glands absent. **Spikelets** 1.5-2.5 mm wide; 6.5-11.8 mm long. **Florets** 4-6; oblong to ovate, or obovate; lowest or first floret 6.5-12.5 mm long. **Fertile florets** 1 to 3. **Sterile florets** 2 to 4. **Callus** indumentum less than 1/2 the

length of the floret body. *Glumes* longer than the florets and partially hiding them. **Lower glumes** 3.8-7 mm long; 1-2.5 mm wide; ovate, or lanceolate; indumentum glabrous or scabrous; glands absent or rarely present; midnerves indumentum scabrous or glabrous; apices bifid, entire or erose; awns present, or absent, 0.1-1.3 mm long, indumentum scabrous, glands absent. **Upper glumes** 4.5-7 mm long; 1.3-3 mm wide; ovate, or lanceolate; indumentum glabrous; glands absent or rarely present; midnerves indumentum scabrous; apices bifid, entire or erose; awns present or absent, 0.1-1.8 mm long, indumentum scabrous, glands absent. **Lemmas** ovate or obovate or occasionally oblong; 2-3.5 mm long; 1.8-3 mm wide; indumentum of outer surfaces pubescent or puberulent; indumentum of inner surfaces pubescent or puberulent, restricted to apex. **Awns** 12-26 or more; 5.3-10 mm long; capillary or slender; stramineous or purple. **Paleas** enclosed completely by lemmas; ovate to elliptic or lanceolate; 1.8-4.5 mm long; 0.8-1.8 mm wide; indumentum glabrous or scabrous or puberulent. **Nerves** indumentum scabrous or puberulent; glands absent, or rarely present. **Awns** present; 2 or 3. **Anthems** oblong; 0.3-0.8 mm long; yellow or orange or red or rust. **Stigmas** purple. **Caryopses** ovate to elliptic or obovate; brown; 0.8-2 mm long; 0.3-1 mm in diameter. Found in Argentina, Bolivia, Brazil, Paraguay, Uruguay, Venezuela, and Colombia.

***Pappophorum mucronulatum* Nees**

Agrost. Bras. 2:412. 1829. - Brazil --from Reeder and Toolin  
in Mart. F. Bras. ii. 412. Brazil (no date given)

Specimens examined. LOCALITY UNKNOWN. *Fotius* 3257 (F); *Raunrer* 1735 (MO). BRAZIL. *Filueiras* 872 (MO); *Swallen* 4364 (US). **Alagoas**. *Chase* 7815 (F, MO, US). **Bahia**. *Harley et al.* 16392 (MO); *Harley et al.* 16378 (MO); *Pinto* 0210 (US); *Lofgreu* 3754 (US). **Pernambuco**. *Tickel* 2331 (US); *Pickel* 1567 (US); *Pickel* 2331 1/2 (US); *Tenorio s.n.* (ARIZ). **Sao Paulo**. *Sendulsky* 1442 (MO). COLOMBIA. *Juzepczuk* 4731 (US). **Boyaca**. *Cuatrecasas & Barriga* 9830 (US). **Cundinamarca**. *Davidse et al.* 5574 (MO). **Tolima**. *Woronow & Juzepczuk* 4906 (US). HONDURAS. **Islas de la Bahia**. *Nelson* 8471 (MO). VENEZUELA. *Burandt* V0205 (MO); *Escalona & Escalona* V217 (MO); *Pittier* 15152 (US). **Anzoategui**. *Davidse et al.* 4976 (MO). **Bolivar**. *Davidse et al.* 4615 (F, MO). **Carabobo**. *Pittier* 9057 (US); *Pittier* 8888 (US). **Caracas**. *Bailey & Bailey* 49 (BH, US); *Pittier* 7360 (US); *Berry* 401 (MO). **Tumerito**. *Pittier* 13693 (US).

**Culms** 28-151 cm tall. **Nodes** constricted; stramineous or yellow-brown or purple; indumentum glabrous; glands present, or rarely absent. **Internodes** indumentum glabrous or occasionally pilose; glands present or rarely absent. **Sheaths** indumentum pilose or glabrous, sometimes arising from pustules; margins glabrous or scabrous or scabrous and puberulent; glands present, or absent. **Ligules** 0.3-0.8 mm long. **Collars** constricted or not constricted; stramineous or purple; indumentum glabrous. **Blades** 2.8-8.5 mm wide; 12.5-55.5 cm long. **Adaxial surfaces** indumentum scabrous or scabrous and pilose;

glands absent or present. **Abaxial surfaces** indumentum glabrous or pilose; glands present or absent. **Margins** indumentum scabrous; glands present or rarely absent. **Bases of blades** flared; indumentum usually pubescent. **Panicles** stramineous to purplish; densely contracted to loosely contracted; erect; ovate or oblong or lanceolate to trullate; 2-7 cm wide (0.8-2); 21-44 cm long (11-19). **Peduncles** 7.5-53 cm long; glands present or absent. **Central axes** slender, or stout; 0.8-1.3 mm wide; indumentum scabrous or glabrous; glands present, moderately abundant to abundant. **Branches** appressed; slender; 0.4-0.6 mm wide; 1.5-7.1 cm long; indumentum scabrous or rarely glabrous; glands present, sparse to abundant. **Pedicels** capillary; 0.2-0.3 mm wide; indumentum scabrous; glands present, moderately abundant to abundant. **Spikelets** 0.8-2 mm wide; 7.3-11 mm long. **Florets** 3-5; oblong; lowest or first floret 6-11 mm long. **Fertile florets** 1 to 3. **Sterile florets** 1 to 3. **Callus** indumentum less than 1/2 the length of the floret body. **Glumes** unequal; longer than the florets and partially hiding them. **Lower glumes** 3-6 mm long; 0.8-1.8 mm wide; lanceolate or ovate; indumentum glabrous; glands present; midnerves indumentum scabrous; apices bifid or entire or erose; awns present, 0.1-0.8 mm long, glands absent. **Upper glumes** 3.5-6.3 mm long; 0.8-2.5 mm wide; lanceolate or ovate; glands present; midnerves indumentum scabrous; apices bifid or entire or erose; awns present, 0.1-0.8 mm long, glands absent. **Lemmas** oblong; 1.8-4 mm long; 1.5-2.5 mm wide; indumentum of outer surfaces pubescent; indumentum of inner surfaces glabrous. **Awns** 10-19; 3-9 mm long; capillary; stramineous or purple. **Paleas** enclosed completely by lemmas; ovate or lanceolate; 2.5-4 mm long; 0.8-1.6 mm wide. **Nerves** indumentum scabrous; glands absent or present. **Awns** present or absent; 1 to 3. **Anthers** 0.4-0.8 mm long; yellow. **Stigmas** purple. **Caryopses** elliptic or ovate or obovate; brown; 0.8-1.6 mm long; 0.5-2 mm in diameter. Found in Brazil, Colombia, Venezuela, and Islas de Bahia of Honduras.

***Pappophorum pappiferum* (Lam.) Kuntze**

Rev. Gen. Plant. 3(2): 365. 1898.

*Saccharum pappiferum* Lamarack, Illustr. des Generes 1: 155. 1791.

*Pappophorum alopecuroides* Vahl, Symb. Bot. 3:10, lam. 51. 1794.

*Pappophorum laguroideum* Schrad. in Roemer et Schlutes, Mant. II. Syst. Veget.: 342. 1824.

*Pappophorum macrostachyum* Schrad. in Roemer et Schultes, Mant. II. Syst. Veget. : 342. 1824.

*Pappophorum elongatum* Sprengel, Syst. iv. Cur. Post. I: 34, n° 8. 1827.

*Pappophorum macrostachyum* Schrad. a Nees ab Esenb., Agrost. Bras.: 411. 1829.

*Pappophorum polystachyum* Kunth, Rev. Gram. II: 131. 1831.

*Pappophorum alopecuroides* Vahl var. *glabrum* Doell, in Mart., Fl. Bras. 2(3): 59. 1878. - Brasil, Venezuela, Mexico (Vera Cruz), and Martinique.

*Pappophorum alopecuroides* Vahl. var. *b pilosiusculum* Doell, in Mart., Fl. Bras. 2(3):59. 1878.

*Pappophorum saccharoides* Griseb., in Abh. Königl. Ges. Wiss. Göttingen 24: 301.

1879. - Paraguay.

Specimens examined. LOCALITY UNKNOWN. Collector unknown s.n. (LP); Collector unknown s.n. (MO #2066730); Collector unknown s.n. (MO #2109988); Smith s.n. (F #139237); Salzmann s.n. (US); Collector unknown s.n. (US #1645118); Tenorio 66-141 (US); Collector unknown 39 (MO); Oliveira 497 (MO); Oliveira 460 (MO); Fernandez 1331 (MO); Ranti-Hitoa 18451 (US); Asplund 10452 (US); Fagerlind & Wibom 1314 (MO); Peterson & Persaud 7448 (US). ARGENTINA. Rojas 133 (US); Rojas 133a (US); Venturi 1974 (US); Venturi 2546 (US); Schreiter 4501 (MO). **Buenos Aires.** Castellanos 1702 (ARIZ). **Catamarca.** Jorgensen 1708? (SI, US #1914350, US #2182628, US #922074, US #1859631); Jorgensen 1700 (MO); Parodi 14073 (LP); Venturi 7150 (US). **Chaco.** Holmberg 40739 (ARIZ); Schulz 3885 (F, MO, SI); Schulz 3303 (F); Stuckert 12? (MO #2883439); Schulz 1150 (US); Baez 39 (SI); Schulz 921 (US); Bazzi 170 (SI); Jorgensen 3099 (MO). **Cordoba.** Stuckert 13808 (MO); Lossen s.n. (MO); Beetle H-S-559 (US); Stuckert 14039 (MO); Bridarolli 1555 (LP); Collector unknown s.n. (SI); Sayago 1519 (SI); Stuckert 15844 (MO); Burkart 10215 (SI); Conrad & Dietrich 2445 (MO); Giardelli 1044 (SI); Stuckert 9167 (US); Stuckert 8960 (MO); Lossen s.n. (F) Stuckert 17122 (MO); Stuckert 12997 (US); Niedfeld 6477 (US); Rosengurtt B-7620 (F); Stuckert 11262 (US); Lossen s.n. (BH). **Corrientes.** Pedersen 1747 (LP, US); Pedersen 10055 (MO, LP); Quarin 2390 (US); Schinini & Mroginski 4458 (F); Schwarz 9958 (MO, US); Schinini & Crovetto 12788 (MO); Pedersen 6998 (US); Schwarz 9874 (MO). **Cucuman.** Schreiter 4501 (US). **Formosa.** Jorgensen 3099 (US). **La Rioja.** Burkart 12180 (SI). **Santiago del Estero.** Venturi 5415 (F); Venturi 5715 (MO, SI, US). **Salta.** Nuvara 3083 (LP); Lilio 4465 (US); Meyer 12170 (MO, US); Meyer 3578 (LP, US); Stephens & Martlez SH59 (US); Abbiatti & Claps 47 (LP); Biraben & Biraben 1412 (LP); Saravia et al. 10039 (US); Parodi 13583 (US); Malvarez 327 (MO, US); Novar 3083 (MO); Cabrera 3116 (F); Borsini 657 (ARIZ); Cabrera & Marchionni 13041 (LP); Medina & Guezzo 101980 (F); Cabrera 26531 (LP). **San Isidro.** Burkart 23235 (US). **San Juan.** Kiesling & Megloli 6617 (SI). **San Luis.** Anderson 1290 (LP); Bartlett 20592 (SI, US); Vignati 408 (LP). **Santa Fe.** Job 1174 (LP, SI). **Tucuman.** Venturi 725 (SI, US); Venturi 1551 (US); Venturi 2546 (F); Venturi 2802 (MO); Venturi 1974 (LP); Venturi 1980 (US); Schreiter 8467 (MO). **Renvoize & Cope** 4226 (US). **Chuquisaca.** Renvoize et al. 3880 (US). **Cochabamba.** Holway 367 (US); Cardenas 2452 (US). **La Paz.** Renvoize 4226 (MO). **Santa Cruz.** Killeen 1308 (ARIZ, F); Killeen 1684 (ARIZ, F, MO). BRAZIL. Davidse et al. 11834 (MO). **Bahia.** Davidse et al. 11665 (MO); Allem & Vieira 1740 (MO). **Corumba.** Allem et al. 2234 (MO); Allem & Vieira 1272 (MO). **Maracas.** Mori & King 12175 (MO, US). **Mato Grosso.** Allem & Vieira 1315 (MO). **Pernambuco.** Pickel 2331 (F). **Ponta Pora.** Swallen 9468 (US). **Prauby.** Gardner 2337 (US). **Rodovia.** Belem & Mendes 352 (US). CARIBBEAN ISLANDS (WEST INDIES). Thomas 112 (US). **Antigua.** Box 69 (US); Box 87 (US); Box 106 (US). **Dominica.** Wilbur et al. 8130 (US); Webster 13454 (US); Wilbur et al. 7595 (US); Collector unknown s.n. (US); Ernst 1966 (US). **Guadeloupe.** McKee 10541 (US). **Martinique.** Steble 2079 (US); Duss 1329 (MO, US). **Saint Thomas, Virgin Islands.** Eggen s.n. (US). COLOMBIA. Mutis 5548 (US); Mutis 5547 (US). **Sabanilla.** Hitchcock 9939 (US). **Santa Marta.** Smith 2536 (MO, US). CUBA. **Havana.** Leon 2010 (US); Leon 9028 (US); Leon 4151 (US); Ehman 952 (US); Ehman 13149 (US); Collector unknown s.n. (US). **Tricornia.** Hitchcock 254 (US). ECUADOR. Acosta 10580 (US); Peterson et al. 9066 (MO). **Azuay.** Peterson 8921 (US). **Carchi.** Peterson 9095 (MO). **Imbabura.** Solis 19042 (US); Breuninger 328 (ARIZ); Acosta-Solis 14838 (US); Breuninger 342 (ARIZ); Mexia 7365 (US). **Pichincha.** Acosta-Solis 16298 (US); Asplund 7044 (LP); Jaramillo 7639 (MO); Acosta-Solis 11317 (US); Acosta 16398 (US); Acosta-Solis 10322 (US). **Tabaruela.** Stroehlein & Smith s.n. (ARIZ, US). MEXICO. **Coahuila.** Starr 87-067 (ARIZ). **Islas Maria Madre, Islas Tres Marias.** Ferris 5616 (MO). **Oaxaca.** Hitchcock s.n. (BH, MO); Pringle s.n. (BH, MO). **Veracruz.** Casasola et al. 153 (MO). PARAGUAY. **Caballerouie** 4921 (US); Hassler 12470 (US). **Chaco.** Rojas 2278 (US); Rosengurtt B-5837 (F, US); Rosengurtt B-5843 (LP, US); Castany 8 (SI). **Fte. Enciso National Park.** Vavrek 371 (US). **Pilcomayo River.** Morong 1071 (F, MO, US). **Puerto Casado.** Hartley SH121 (US). **Ypacaray.** Hassler 12870 (MO);

Hassler 12470 (US). PERU. *Raula-Hirsch* 1367 (US); *Ellenberg* 5054 (MO); *Weberbauer* 6462 (F, US). **Abancay.** *Chavez* 3218 (MO). **Anta.** *Vargas* 14346 (US). **Chiclayo.** *Llatas* 363 (MO). **Huanuco.** *Ferreyra* 6876 (US); *MacBride* s.n. (US); *MacBride* 3238 (F); *Ellenberg* 3972 (MO); *Ellenberg* 2206 (US); *Nunez* 2542 (US). **Huarochiri.** *Goodspeed & Weberbauer* 33070 (MO, US); *Sanchez* 2963 (F, MO). **Lima.** *Goodspeed* 33159 (MO). PUERTO RICO. *Hess* 427 (US); *Hess*, 1607 (US); *Britton et al.* 4689 (US). **Mona Island.** *Britton et al.* 1777 (US); *Hess* 444 (US). TRINIDAD. *Collector unknown* s.n. (US). VENEZUELA. *Vogl* 671 (F). **Federal District.** *Davidse* 2886 (MO). **Liberatador.** *Steyermark & Espinoza* 112733 (MO). **Miranda.** *Davidse* 2909 (MO). **Trujillo.** *Steyermark* 56757 (F); *Chase* 12388 (US). **Vargas.** *Castillo* 2535 (MO); *Zuloaga & Ortiz* 4297 (MO). **Zulia.** *Bunting* 9361 (MO).

**Culms** 13.5-206 cm tall. **Nodes** constricted or equal in diameter to internodes; brown or stramineous; indumentum glabrous; glands absent. **Internodes** indumentum glabrous; glands absent. Sheaths margins indumentum scabrous or scabrous and puberulent or pilose; glands absent. **Ligules** 0.3-1.5 mm long. **Collars** constricted or not constricted; stramineous, or purple; indumentum glabrous. **Blades** 1-7 mm wide; 17.5-58 cm long. **Adaxial surfaces** indumentum scabrous or scabrous and pilose; glands absent. **Abaxial surfaces** indumentum glabrous or pubescent; glands absent. **Margins** indumentum scabrous; glands absent. **Bases of blades** flared; indumentum glabrous or pubescent. **Panicles** silvery and silky; open or loosely to densely contracted; erect; lanceolate or trullate; 0.6-10.5 cm wide; 14.5-81 cm long. **Peduncles** 4-39 cm long; inserted in sheath; glands absent. **Central axes** slender to stout; 0.6-1.5 mm wide; indumentum scabrous; glands absent. **Branches** slender; 0.4-0.6 mm wide; 1.4-7 cm long; indumentum scabrous; glands absent. **Pedicels** reflexed at spikelet maturity; capillary; 0.2-0.3 mm wide; indumentum scabrous; glands absent. **Spikelets** 0.8-1.3 mm wide; 7-13 mm long. **Florets** 3-5; elliptic, or oblong, or ovate; lowest or first floret 4.5-13.5 mm long. **Fertile florets** 1 to 2. **Sterile florets** 1 to 4. **Callus** indumentum less than 1/2 the length of the floret body. **Glumes** equal to unequal; longer than the florets and partially hiding them. **Lower glumes** 2.5-6.5 mm long; 0.2-2.2 mm wide; lanceolate or ovate; indumentum glabrous or scabrous; glands absent; midnerves indumentum scabrous; apices bifid or entire or erose; awns present or absent, 0.1-0.8 mm long, indumentum scabrous, glands absent. **Upper glumes** 0.3-6.8 mm long; 0.5-2.3 mm wide; lanceolate or ovate; indumentum glabrous or scabrous; glands absent; midnerves indumentum scabrous or glabrous; apices bifid or entire or erose; awns present or absent, 0.1-0.5 mm long, glands absent. **Lemmas** elliptic or ovate or oblong; 1-3.3 mm long; 1-2.5 mm wide; indumentum of outer surfaces pubescent; indumentum of inner surfaces glabrous or scabrous. **Awns** 12-26; 3.5-11 mm long; capillary; purple, tend to hide or obscure the floret bodies. **Paleas** enclosed completely by lemmas; lanceolate or ovate; 1.5-3.8 mm long; 0.3-1.3 mm wide; indumentum glabrous. **Nerves** indumentum scabrous; glands absent. **Awns** present or absent; 1 to 3. **Anthers** 0.3-0.7 mm long; yellow or orange. **Stigmas** purple. **Caryopses** oblong or elliptic or obovate; brown or yellowish-brown; 0.5-2.3 mm long; 0.3-1 mm in diameter. Found in Argentina, Bolivia, Brazil,



Colombia, Caribbean Islands, Cuba, Ecuador, Mexico, Paraguay, Peru, Trinidad, and Venezuela.

***Pappophorum philippianum* Parodi**

Revista Mus. La Plata, Secc. Bot. 8(40): 79. 1943.

*Pappophorum vaginatum* Philippi, Anales Univ. Chile 36: 206. 1870.

No Buckley 1866.

*Pappophorum pappiferum* (Lam.) O.K. var. *g mucronulatum* (Nees) O. Kuntze, Rev. Gen. Pl. 3(2): 365. 1898.

*Pappophorum mucronulatum* Nees var. *subsimplex* Hackel, en Stuckert, Anales Mus. Nac. Hist. Nat. Buenos Aires. 13: 495. 1906.

*Pappophorum mucronulatum* Nees forma *intermedia* Hackel, en Stuckert, Anales Mus. Nac. Hist. Nat. Buenos Aires. 21:123. 1911.

*Pappophorum mucronulatum* Nees var. *vaginatum* (Philippi) Hackel, en Stuckert, Anales Mus. Nac. Hist. Nat. Buenos Aires. 21:123. 1911.

Specimens examined. LOCALITY UNKNOWN. Stuckert 20052 (US); Collector unknown s.n. (US #1645117). ARGENTINA. Hammel 5924 (MO); Stuckert 238 (MO); Ellenberg 4517 (MO); Wahnish 2050 (SI). **Buenos Aires.** Sanchez & Arriaga 1331 (SI). **Catamarca.** Cantino 787 (ARIZ); Jorgensen 1355 (MO, US); Jorgensen s.n. (US); Brizuela 461 (LP, US); Cantino 602 (ARIZ); Parodi 14362 (LP); Parodi 13940 (LP); Biraben & Biraben 1181 (LP); Sleumer & Vervoorst 2328 (US); Cantino 450 (ARIZ); Cantino 637 (ARIZ); Brizuela 183 (US); Nicora 18507 (SI); Brizuela 478 (MO, US); Agusti s.n. (ARIZ). **Cordoba.** Lossen s.n. (BH, F); Rosengurtt? s.n. (MO); Nicora 17535 (SI); Collector unknown s.n. (MO #2879314); Bartlett 20145 (US); Stuckert 14708 (MO); Stuckert 5372 (US). **Corrientes.** Pedersen 1350 (US); Schinini & Abumada 12360 (MO); Pedersen 11558 (MO); Schinini 5324 (F). **Entre Rios.** Burkart et al. 21077 (SI, US); Burkart 25261 (SI). **La Poma.** Nicora 9159 (SI). **La Rioja.** Stuckert 17259 (MO); Lahiffe & Castro 11 (US); Venturi 7822 (MO, US); Stuckert 17216 (SI); Cabrera et al. 24634 (LP); Ballespin s.n. (LP); Dawson 3434 (LP); Dawson 3398 (LP); Nicora s.n. (SI); Deuzati s.n. (US). **Mendoza.** Collector unknown s.n. (LP); Covas 688 (SI); Covas 3424 (SI); Carette s.n. (ARIZ, US); Caceres 46 (US); Melis & Barkley s.n. (US); Caceres 22 (US); Wilczek 536 (US); Leal 17185 (ARIZ); Melis et al. 569 (US); Contardi 9 (LP); O'Boelcke et al. 9907 (MO); Burkart et al. 13875 (SI); Covas 975 (US); Jensen-Hoarui 05 (US); Schulz 6182 (F); Bartlett 19436 (US); Parodi 4826 (US); Paci 820 (US); Melis & Paci 288 (US). **Rio Negro.** Cabrera 19550 (LP). **Salta.** Job 1481 (LP); Lorentz & Hieronymus 376 (F); Lorentz & Hieronymus 346 (US). **San Juan.** Nicora et al. 8434 (MO, SI); Cabrera et al. 24545 (LP); Rtuezzo 362 (US). **San Luis.** Jacobis 40 (SI); Semper s.n. (US #2043845); Semper s.n. (MO #1824886); Anderson 1289 (LP); Guinazii 20 (LP); Covas 1005 (LP); Cabrera et al. 17886 (LP); Bruch-Carette s.n. (LP). **Santa Fe.** Job 850 (US); Ragonese 2079 (F, LP); Pensiero 352 (MO). **Santiago del Estero.** Bruzzone 1590 (LP); Bruzzone 513 (LP); Bartlett 19739 (US); Venturi 10168 (MO). **Tucuman.** Venturi 2439 (US); Venturi 4474 (LP); Schinini 5304 (F); Collector unknown s.n. (MO #1308796); Lillo 4853 (MO, US); Rodriguez 248 (MO, US); Venturi 639 (SI, US). BOLIVIA. Solomon & Nee 16071 (MO); Brooke 5117 (F). **La Paz.** Renvoize et al. 4225 (MO, US). BRAZIL. **Corumba.** Allem & Vieira 1388 (MO); Allem & Vieira 954 (MO). **Iacu.** Mori 13278 (MO). MEXICO. **Sonora.** Martin & O'Rourke s.n. (ARIZ #262162); Martin & O'Rourke s.n. (ARIZ #269151); Jones 23440 (MO); Burgess et al. 6912 (ARIZ); Bailey 119 (BH). PARAGUAY. Hassler 2596 (MO). **Asuncion.** Martley & Rojas SH190 (US); Rosengurtt B-5429 (US); Rojas 2775 (US). **Chaco.** Anderson 1177 (US); Rosengurtt 5486 (US). **Jardin.** Archer 4940 (US). **Puerto Casado.** Hartley SH131 (US). USA. **Texas.** Nealley s.n. (BH).

**Culms** 8.5-108 cm tall. **Nodes** constricted; indumentum glabrous; glands absent. **Internodes** indumentum glabrous or scabrous to pilose; glands absent. **Sheaths** margins indumentum scabrous or pilose; glands absent. **Ligules** 0.3-1.5 mm long. **Collars** constricted; stramineous or purple; indumentum glabrous. **Blades** 1.5-3 mm wide; 4.5-19 cm long. **Adaxial surfaces** indumentum scabrous or scabrous and pilose; glands absent. **Abaxial surfaces** indumentum glabrous or pilose; glands absent. **Margins** indumentum scabrous; glands absent. **Bases of blades** flared; indumentum glabrous or pubescent. **Panicles** stramineous; loosely contracted; ovate or oblong or lanceolate; 0.5-2.5 cm wide; 4.5-25.5 cm long. **Peduncles** 3.5-37.5 cm long; inserted or not inserted in sheath; glands absent. **Central axes** slender to stout; 0.5-1 mm wide; indumentum scabrous; glands present or absent. **Branches** appressed; slender; 0.3-0.6 mm wide; 1-4.2 cm long; indumentum scabrous; glands present or absent. **Pedicels** capillary; 0.2-0.3 mm wide; indumentum scabrous; glands present or absent. **Spikelets** 1.3-3 mm wide; 7-16 mm long. **Florets** 4-8; oblong or elliptic or ovate; lowest or first floret 9-15 mm long. **Fertile florets** 1 to 5. **Sterile florets** 2 to 3. **Callus** indumentum greater than 1/2 the length of the floret body. **Glumes** subequal to unequal. **Lower glumes** 4-10.3 mm long; 1.25-5 mm wide; lanceolate or ovate; glands present or absent; midnerves indumentum scabrous or glabrous; apices entire; awns present, 0.2-1.8 mm long, glands absent or rarely present. **Upper glumes** 5-10.5 mm long; 2-4 mm wide; lanceolate or ovate; glands present or absent; midnerves indumentum glabrous or scabrous; apices entire; awns present, 0.1-2.8 mm long, glands absent or present. **Lemmas** oblong or ovate or obovate; 2.25-4 mm long; 1.25-4 mm wide; indumentum of outer surfaces pubescent, greater than 1/2 the length of the lemma bodies; indumentum of inner surfaces pubescent or puberulent. **Awns** 12-26 or more; 5-12.5 mm long; capillary to slender; purple or stramineous. **Paleas** enclosed completely by lemmas; ovate or lanceolate or elliptic; 2.5-6 mm long; 0.8-2 mm wide; indumentum glabrous or scabrous. **Nerves** indumentum scabrous or puberulent; glands present or absent. **Awns** present; 1 to 3. **Anthers** 0.7-1 mm long; yellow or orange. **Stigmas** purple. **Caryopses** oblong or elliptic or ovate; yellowish-brown or brown; 0.8-3 mm long; 0.3-1.5 mm in diameter. Found in Argentina, Bolivia, Brazil, Mexico, and Texas, USA.

***Pappophorum vaginatum* Buckley**

Prelim. Rep. Geol. and Agric. Surv. Texas App. 1. 1866, non Philippi, 1870.

*Pappophorum apertum* Munro ex Scribner. Bull. Torrey Bot. Club. 9: 148. 1882. - N. Mexico.

*Pappophorum apertum* Munro ex Scribner var. *vaginatum* (Buckley) Scribner ex L. Dewey. Contr. U.S. Natl. Herb. 2: 535. 1894.

*Pappophorum caespitosum* R.E. Fries. Nova Act. Regiae Soc. Sci. Upsala. 4(1): 177, lam. 9, figs. 5-6. 1905. - Argentina.

*Pappophorum subbulbosum* Arechav., Anales Mus. Nac. Montevideo. 1:405. pl. 48.

1896.

*Pappophorum macrostachyum* Schrad. b Nees ab Esenb., Agros. Bras.: 411. 1829.

*Pappophorum polystachyum* vaarietas Kunth, Revis. Gram. II: 132. 1831.

*Pappophorum mucronulatum* Nees forma *elatio*r Stuckert, Anales Mus. Nac. Hist. Nat. Buenos Aires. 11: 123. 1904.

*Pappophorum macrospermum* Roseng., B. R. Arill., and Izag. Gram. Urug. : 397, fig. 178. 1969.

Specimens examined. LOCALITY UNKNOWN. Collector unknown s.n. (LP); Lossen s.n. (MO); Scolnik 1743 (SI). ARGENTINA. Nutall? s.n. (US); Venturi 566 (SI, US); Fries 804 (US). Buenos Aires. Parodi 10474 (LP); Isabel et al. 354 (LP); Cabrera 1066 (LP); O'Boelcke et al. 11931 (LP); Cabrera & Fabris 16431 (LP); Krapovickas 2619 (MO, US); Vikamil & Nicora 2164 (SI); Edyerdam et al. 23508 (F, MO, US); O'Boelcke 8542 (MO); Krapovickas 2588 (US); Burkart 25606 (SI). Catamarca. Cantino 690 (ARIZ); Bartlett 19603 (US); Brizuela 279 (F); Sayago 1511 (SI); Parodi 14207 (US); Cabrera et al. 16750 (LP). Cordoba. Castellanos 13 (F); Stuckert 13807 (MO); Krapovickas 7293 (SI); Parodi 7488 (US); Kurtz 13288 (LP); Cabrera et al. 31226 (SI); Stuckert 238 (US); Toleds 1280 (MO); Killip 39557 (US); Lossen s.n. (BH, F); Stuckert 12448 (MO); Stuckert 10213 (US); Stuckert 18472 (MO); Stuckert 11 (US); Solomon 4108 (MO); Stuckert 11253 (MO); Krapovickas 6623 (SI); Sanchez & Arriaga 1273 (SI); Stuckert 11042 (MO); Castellanos 89 (F, SI); Stuckert 11259 (MO, US); Burkart 10143 (SI). Entre Rios. Burkart 24068 (SI); Burkart & Troncoso 26148 (SI). Jujuy. Fries 804 (US); Okada 3773 (LP); Meyer 3143 (F); Budui s.n. (US); Correll et al. A671 (US). La Pampa. Conrad 2403 (MO); Cabrera et al. 32814 (SI); Itrie 17410 (SI). La Plata. Parodi 88 (US); Cabrera 6300 (LP). La Rioja. Parodi 14845 (US); Burkart 12204 (SI); Burkart 12207 1/2 (SI); Covas 1303 (LP). Mendoza. Parodi 4876 (US); Haarcip s.n. (US); Parodi 4841 (US); Covas 3648 (SI); Covas 1570 (SI); Barkley 19AR802 (US); Bocher et al. 2211 (MO); Covas 1280 (SI); Leal & Paci 488 (US); O'Boelcke et al. 9907 (MO). Rio Negro. Fischer 43 (US); Nicora 4005 (SI); Fischer 43 (F, MO). San Isidro. Burkart 17775 (US). San Juan. Nicora et al. 8431 (MO). San Luis. Anderson 1235 (LP). Santa Fe. Niedfela 39 (US); Balegno 768 (US); Biraben 180 (LP); Job 1113 (LP). Santiago del Estero. Maldonado Bruzzzone 921 (LP). URUGUAY. Arechavaleta s.n. (US). Montevideo. Collector unknown s.n. (MO). Paysandu. Rosengurtt B-4593 (US); Rosengurtt B-4924 (US); Rosengurtt B-4593 1/2 (US). Rio Negro. Rosengurtt B-4113 (US). Sorano. Schroun 19553 (US). BOLIVIA. Farija. Fries 1099 (US). Santa Cruz. Solomon & Nee 17997 (MO). BRAZIL. Pernambuco. Chase 7767 (F). MEXICO. Coahuila. Johnston 8641 (MO); Van Devender et al. 84-632 (ARIZ); Nee & Diggs 25324A (MO); Reeder & Reeder 4517 (ARIZ); Chiang et al. 8275 (MO); Chaing et al. 9105 (MO); Chiang et al. 9057 (MO). Durango. Wagner & Brown 3930 (MO). San Luis Potosi. Reeder & Reeder 4268 (ARIZ). Saltillo. Palmer 377 (MO); Hitchcock 450 (MO). Sonora. Reeder & Felger 8090 (ARIZ). USA. Reverchon s.n. (MO). Arizona. Pringle 13924 (MO); Maguire & Maguire 11210 (BH); Pringle s.n. (BH, MO); Hitchcock 449 (BH, MO); Thomber 206 (MO); Thieret & Brandenburg 53004 (MO); Wootton s.n. (BH). Florida (Santa Cruz). Renvoize et al. 4065 (MO, US). Texas. Palmer 33874 (MO); Young s.n. (MO); Orcutt 5725 (MO); Tracy 8905 (BH, MO); Orcutt 5733 (MO); Wright 803 (MO #2975956); Mackenzie 113 (MO); Tharp 43-502 (MO); Eggert s.n. (MO); Perkins & Hall 2041 (BH); Buckley 1883 (BH).

**Culms** 20-101 cm tall. **Nodes** constricted; purple or brown and purple; indumentum glabrous; glands absent. **Internodes** indumentum glabrous or scabrous to pilose; glands absent. **Sheaths** margins glabrous; glands absent. **Ligules** sometimes appearing as two sets; 0.5-2 mm long. **Collars** constricted, or not constricted; stramineous; indumentum glabrous. **Blades** 2-5 mm wide;

7-49 cm long. **Adaxial surfaces** indumentum scabrous or scabrous and pilose; glands absent. **Abaxial surfaces** indumentum glabrous or pilose, sometimes arising from tubercles; glands absent. **Margins** indumentum scabrous; glands absent. **Bases of blades** flared; indumentum pubescent or glabrous. **Panicles** stramineous and purplish; densely contracted; ovate or oblong or lanceolate; 0.5-2 cm wide; (6.5) 11-30 (41)cm long. **Peduncles** 7-25 cm long; glands absent. **Central axes** slender to stout; 0.5-1 mm wide; indumentum scabrous; glands absent. **Branches** appressed; slender; 0.3-0.5 mm wide; 0.8-2.7 cm long; indumentum scabrous; glands absent. **Pedicels** capillary; 2 mm wide; indumentum scabrous; glands absent. **Spikelets** 1-1.8 mm wide; 5-11 mm long. **Florets** 4-6 (3); oblong or elliptic or ovate; lowest or first floret 5.2-9.2 mm long. **Fertile florets** 1 to 3. **Sterile florets** 2 to 4. **Callus** indumentum less than 1/2 the length of the floret body. **Glumes** subequal to unequal; longer than the florets and partially hiding them. **Lower glumes** 2.2-5.5 mm long; 0.8-2 mm wide; ovate or lanceolate; glands absent; midnerves indumentum glabrous or scabrous; apices bifid or erose; awns present or absent; 0.1-1 mm long; glands absent. **Upper glumes** 2.5-6 mm long; 1.2-2.3 mm wide; ovate or lanceolate; glands absent; midnerves indumentum glabrous or scabrous; apices bifid or erose; awns present or absent; 0.1-1 mm long; glands absent. **Lemmas** ovate or oblong or obovate; 1.5-35 mm long; 1.5-3.5 mm wide; indumentum of outer surfaces pubescent; usually less than 1/2 the length of lemma bodies; indumentum of inner surfaces glabrous or scabrous. **Awns** 12-26; 3.3-7.5 mm long; capillary; purple or stramineous. **Paleas** enclosed completely by lemmas; ovate or elliptic; 2-4.3 mm long; 0.5-1.8 mm wide; indumentum glabrous. **Nerves** indumentum scabrous; glands absent. **Awns** present or absent; 1 to 3. **Anthers** 0.5-0.8 mm long; yellow or brown. **Stigmas** purple. **Caryopses** elliptic; brown; 0.5-2.8 mm long; 0.2-1 mm in diameter. Found in Argentina, Bolivia, and Brazil.

## LITERATURE CITED

- Beetle, A.A. 1987. Noteworthy grasses from Mexico XIII. *Phytologia*. 63: 209-297.
- Burkart, A. 1969. *Flora Ilustrada de Entre Rios (Argentina)*, part II. Gramineas. Buenos Aires.
- Cabrera, A.L. 1970. *Flora de la Provincia de Buenos Aires*, part II. Gramineas. M. EnCorrea, editor. Buenos Aires. 349-351.
- Clayton, W.D. and S.A. Renvoize. 1986. *Genera Graminum Grasses of the world*. Kew Bulletin Additional Series XIII. Her Majesty's Stationery Office, London.
- Dallwitz, M.J. and T.A. Paine. 1986. *User's guide to the DELTA system: a general system for processing taxonomic descriptions*, 3<sup>rd</sup> edition. CSIRO Div of Entomology. Canberra, Australia.
- Hitchcock, A.S. 1927. The grasses of Ecuador, Peru, and Bolivia. *Contr. U.S. Natl. Herb.* 24(8):291-556 +index.
- Hitchcock, A.S. 1935. *Manual of the grasses of the United States*. USDA Misc. Publ. 200.
- Hitchcock, A.S. 1950. *Manual of the grasses of the United States*, 2nd edition, revised by A. Chase. USDA Misc. Publ. 200.
- Gatti Clark, L.C. 1997. *Floristic and Biosystematic Investigations in Plant Taxonomy*. Ph.D. dissertation. Oklahoma State University. Stillwater, Oklahoma.
- Gould, G.W. 1975. *The grasses of Texas*. Texas A&M University Press.

College Station, Texas.

- Nicora, E.G. 1978. Flora Patagonica., part III. Gramineae. M. EnCorrea, editor. Buenos Aires. 487-492.
- Pensiero, J.F. 1986. Revision de las sepecies agrentinas del genero *Pappophorum* (Gramineae--Eragrostoideae--Pappophoreae). Darwiniana. 27: 65-87.
- Reeder, J.R. and L.J. Toolin. 1988. *Pappophorum philippianum* (Gramineae) new to North America. Phytologia. 64: 402-403.
- Reeder, J.R. and L.J. Toolin. 1989. Notes on *Pappophorum* (Gramineae: Pappophoreae). Systematic Botany. 14(3): 349-358.
- Renvoize, S.A. 1984. The grasses of Bahia. Her Majesty's Stationery Office, London.
- Rohlf, F.J. 1992. Numerical taxonomy and multivariate analysis system, version 1.70. Exeter Software. Setauket, New York.
- Shaw, E.A. 1987. Charles Wright on the boundary 1849-1852: Plantae Wrightianae revisited. Meckler Publishing Corporation. Westport, Connecticut.
- Swallen, J.R. 1964. Gramineae. In: F. Shreve & I. L. Wiggins, Vegetation and Flora of the Sonora Desert. Stanford University Press. 1: 237-301.
- Watson, L. & M.J. Dallwitz. 1992. The grass genera of the world. CAB International, University Press. Cambridge, England.

## PART III

# SURVEY OF THE VASCULAR FLORA OF THE BOEHLER SEEPS AND SANDHILLS PRESERVE

CHAPTER VIII

SURVEY OF THE VASCULAR FLORA  
OF THE BOEHLER SEEPS AND  
SANDHILLS PRESERVE

Located in Atoka County of south-central Oklahoma, The Nature Conservancy's Bohler Seeps and Sandhills Preserve comprises sandhills, acidic hillside seeps, marshes, intermittent and permanent streams, and shallow lakes. The sandhills are the site of the highest quality, old-growth vegetation of the Western Gulf Coastal Plains (S. Orzell, personal communication to Ian Butler). The flora is a unique assemblage of plants that is present nowhere else in the state and considered globally rare. Approximately 400 species are believed to be present (Jones, 1993). More than 20 rare species have been reported to occur in the area, including some that are globally rare (Oklahoma Natural Heritage Inventory, 1997). *Eriocaulon kornickianum*, for example, is designated G2 and S1. Other rare species in the preserve included *Penstemon murrayanus* (G4, S1S3), *Polygonella americana* (G5, S1S2), and *Paronychia drummondii* (G4G5, S1S2).

Prior to this study, our knowledge of the vascular plant species in the preserve was incomplete. Although several partial lists of its flora had been compiled, a systematic survey of the area to inventory all of the plants had not been conducted. Such information is essential for understanding the



ecology of the site and making decisions about its management. This study was undertaken to provide this information. Specific objectives were to: (1) compile a list of the terrestrial and aquatic vascular plant species present and (2) prepare a set of herbarium specimens to document the preserve's flora. This note summarizes my findings and provides a reference to the information compiled in Gatti Clark (1997).

**Boehler Seeps & Sandhills Preserve** -- The preserve is a 235 ha site located in southern Atoka county, OK approximately 11 miles North of Boswell (S25 & 26, T4S, R13W; Boswell NW Quad). It comprises two tracts bisected by a paved country road and located in the watersheds of Muddy Boggy and Clear Boggy Creeks. Situated in the Dissected Coastal Plain Geomorphic Province and Western Coastal Plain Land Resource Area (Johnson *et al.*, 1979; U.S.D.A. Natural Resources Conservation Service, 1992), its underlying strata are Cretaceous in age. Also underlying the preserve is the Antlers Sandstone Aquifer that is composed primarily of non-marine sand and clay, and marine limestone and clay up to 915 m thick and is saturated with water that has a moderate to high mineral content (Johnson *et al.*, 1979). The water table is generally within 1-1.3 m of the surface, with seeps occurring where it reaches the surface (Jones 1993; personal communication). Soil series of the site are the Bernow-Romia complex, 8-12% slopes; Boggy fine sandy loam; and Larue loamy fine sand, 0-8% slopes (Shingleton and Watterson, 1979). All are susceptible to erosion by both water and wind. Precipitation in the area of the preserve occurs primarily in the spring and summer, and averages 119 cm per year (Ruffner, 1980). The average growing season is 255 days; mean maximum annual

temperature is 24.5°C; mean minimum is 11°C; and the average of days below 0°C is 52 (Ruffner, 1980).

Vegetation of the area is Oak-Hickory Forest (Duck & Fletcher, 1943) with several communities present. *Quercus stellata*, *Carya texana*, *Bumelia lanuginosa* dominate and form an almost continuous canopy in the drier areas. Typically a thick leaf layer is present on the ground and understory vegetation sparse. *Juniperus virginiana* and *Pinus echinata*, while not dominant, can be found scattered throughout the preserve. Common woody understory species are *Nyssa sylvatica*, *Vaccinium arboreum*, *Berchemia scandens* and *Vitis rotundifolia*. Herbaceous understory taxa include *Galium arkansanum*, *G. obtusum*, *Tephrosia virginia*, *Carex* spp., *Cyperus* spp., and *Juncus* spp. Scattered throughout the preserve and most conspicuous are glades dominated by *Aristida desmantha* and *Selaginella rupestris*. Other glades are present and are dominated by various grasses, such as *Panicum* spp., mosses, and forbs, such as *Gaillardia aestivalis* and *Hieracium longipilum*. At the glade edges, trees other than the forest dominants are encountered, in particular *Quercus incana*. Its saplings are occasionally found in the centers of the glades.

Hassel and Boehler Lake are small, shallow bodies of water maintained by beaver dams. Both have dense stands of emergent and floating-leaved species at their edges and open water in their centers. Dominant taxa include *Typha angustifolia*, *Nuphar lutea*, and *Nymphaea odorata*. Often quite abundant, free-floating species are *Azolla caroliniana*, and *Utricularia biflora*. Two types of seeps are present in the preserve. One has water percolating slowly to the surface and accumulating in one area because of the topography. The ground surface has a spongy feel because of the thick carpet of vegetation, primarily mosses; *Sphagnum lescurii* and

*Polytrichum commune* in particular dominate. Occupying natural drainage ways, the second type is characterized by water flowing away from the seepage point. Ferns, sedges, and rushes typically are in abundance along these watercourses. Between the lakes and the seeps are marshes dominated by *Osmunda regalis*, *O. cinnamomea*, *Cephalanthus occidentalis*, *Scirpus* spp., *Rhynchospora* spp., and *Cyperus* spp. Associated with Boehler Lake are rather deep drainages that resemble sloughs. They have less vegetation and are often banked by large trees such as *Quercus falcata*, *Q. nigra*, and *Q. phellos*.

**Method of Survey** -- A systematic collection of the terrestrial and aquatic vascular plants occurring in the preserve was conducted during the 1994 and 1995 growing seasons. The area was divided into three survey units using roads and fences as boundaries. Each unit was traversed on foot several times during the growing season. Plants were collected in both the flowering and fruiting stages, and prepared using standard herbarium techniques (Radford *et al.*, 1974). Specimens previously collected by Conservancy personnel were identified and included in the inventory (Gatti Clark, 1997, Appendices I & J). One set of 440 voucher herbarium specimens (appendix H) was prepared and deposited in the Oklahoma State University Herbarium (OKLA). Identification was accomplished using the resources of the herbarium. Nomenclature used was based primarily on that of Waterfall (1969), Correll and Johnston (1979) and Gray's Manual of Botany (Fernald, 1950). Common names were taken from Correll and Johnston (1979) and Taylor and Taylor (1994).

**Flora of the Preserve** -- Three hundred forty-five species in 225 genera and 84 families were encountered in this survey or by previous workers (Gatti Clark, 1997, Appendices H, I, & J). Three families, Asteraceae (56 taxa), Poaceae (42 taxa), and Cyperaceae (33 taxa) composed 38% of the preserve's vascular flora. Other large families were the Fabaceae (21 taxa), Apiaceae (11 taxa) and Lamiaceae (10 taxa) and Scrophulariaceae (10 taxa). The largest genera present were *Carex*, represented by 17 species, and *Panicum*, represented by 12 species.

Species designated by the U.S. Fish and Wildlife Service (1996) as endangered, threatened, or candidate (formally category 1) were not encountered. Species ranked by the ONHI (1997) as S1 or S2 and present in the preserve included the previously mentioned *Eriocaulon kornickianum* (G2, S1), *Penstemon murrayanus* (G4, S1S3), *Polygonella americana* (G5, S1S2) and *Paronychia drummondii* (G4G5, S1S2)). Other rare species are listed in Table 1.

Although demonstrably secure globally and ranked G4 or G5 by ONHI, several species of interest were found in the preserve. The insectivorous *Drosera brevifolia*, and the mycotrophic/parasitic *Monotropa hypopithys*, were encountered. *Lycopodium appressum* is reported for the site but was not seen in this study or in collections of The Nature Conservancy personnel (L.K. Magrath, personal communication).

With 24 rare taxa reported for the site, monitoring of the Bluejack Oak sandhills and seep communities should continue. The communities and its assemblage of plants at Boehler Seeps and Sandhills Preserve are rare within the state and deserve continued study.

Table 1. Taxa of Boehler Seeps and Sandhills Preserve that are ranked as rare by the Oklahoma Natural Heritage Inventory (ONHI).

Scientific Name	Common Name	ONHI Rankings*	
		Global	State
<i>Agalinis tenuifolia</i> (Vah.) Raf.	Slender Leaved Agalinis	G5	S2S3
<i>Aristolochia reticulata</i> Nutt.	Netleaved Snakeroot	G4	S2
<i>Azolla caroliniana</i>	Mosquito Fern	G5	S2
<i>Brasenia schreberi</i> J.F. Gmel.	Water-Shield	G5	S1
<i>Carex swanii</i> (Fern.) Mack.	Swan Sedge	G5	S1
<i>Carex hyalina</i>	Whitesheath Sedge	G5	S1
<i>Carya myristiciformis</i> (Michx.) Nutt.	Nutmeg Hickory	G5	S2S3
<i>Drosera brevifolia</i> Pursh.	Sundew	G5	S2S3
<i>Dulichium arundinaceum</i> (L.) Britt.	Threeway Sedge	G5	S1
<i>Erianthus giganteus</i> (Walt.) Muhl.	Giant Plumegrass	G5	S1S2
<i>Eriocaulon kornickianum</i> Van Heurch & Muell.-Arg.	Small Pipewort	G2	S1
<i>Galium arkansanum</i> A. Gray	Arkansas Bedstraw	G5	S1S2
<i>Hedyotis australis</i> Lewis & Moore	Bluet	G4G5	S1S2
<i>Iris virginica</i> L.	Southern Blue Flag	G5	S2?
<i>Monotropa hypopithys</i> L.	Pinesap	G5	S1
<i>Paronychia drummondii</i> Torr. & Gray	Drummond's Nailwort	G4G5	S1S2
<i>Penstemon murrayanus</i> Hooker	Cupleaf Beardtounge	G4	S1S3
<i>Platanthera flava</i> (L.) Linl.	Pale Green Orchid	G5	S1
<i>Polygonella americana</i> (Fisch. & Mey.) Small	Southern Jointweed	G5	S1
<i>Quercus incana</i> Bartr.	Bluejack Oak	G5	S1S2
<i>Rhynchospora caduca</i> Ell.	Anglestem Beakrush	G5	S1
<i>Sacciolepis striata</i> (L.) Nash	American Cupscale	G5	S2
<i>Azolla caroliniana</i> Willd.	Mosquito Fern	G5	S2
<i>Carex hyalina</i> Boott.	Whitesheath Sedge	G5	S1

\* ONHI Global Rankings:

G2 - Imperiled globally because of its rarity (6 to 20 occurrences or few remaining individuals or acres) or because of other factors demonstrably making it vulnerable to extinction throughout its range.

G4 - Apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery.

G5 - Demonstrably secure globally though it may be quite rare in parts of its range, especially the periphery.

S1 - Critically imperiled in Oklahoma because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor of its biology making it especially vulnerable to extinction.

S2 - Imperiled in Oklahoma because of extreme rarity (6 to 20 occurrences or few remaining individuals or acres) or because of other factors making it very vulnerable to extinction throughout its range.

S3 - Rare and local in Oklahoma (thought it may be abundant at some of its locations); in the range of 21-100 occurrences.

## REFERENCES

- Correll, D.S. and M.C. Johnston. 1970. Manual of the Vascular Plants of Texas. Texas Research Foundation, Renner, Texas. 1881 pp.
- Duck, L.G. and J.B. Fletcher. 1943. A Game Type Map of Oklahoma. State of Oklahoma Game and Fish Department, Division of Wildlife Restoration. Oklahoma Biological Survey, Norman, Oklahoma.
- Fernald, M.L. 1950. Gray's Manual of Botany, eighth edition. American Book Company, New York. 1632 pp.
- Gatti Clark, L.C. 1997. Floristic and Biosystematic Investigations in Plant Taxonomy. Ph.D. dissertation. Oklahoma State University. Stillwater, Oklahoma.
- Jones, N. 1993. A baseline study of the water quality, vegetative gradients, and hydrology of Boehler Seeps and Sandhills Preserve. Report. The Nature Conservancy, Tulsa, Oklahoma.
- Johnston, K.S., C.C. Branson, N.M. Curtis, Jr., W.E. Ham, W.E. Harrison, M.V. Marcher, and J.F. Roberts. 1979. Geology and Earth Resources of Oklahoma. Educational Publication 1. Oklahoma Geological Survey, Norman, Oklahoma.
- Oklahoma Natural Heritage Inventory. 1997. Short Working List of Rare Plants. Version of 22 January 1997. Distributed by Oklahoma Biological Survey, Norman, Oklahoma.

- Radford, A.E., W.C. Dickison, J.R. Massey, and C.R. Bell. 1974. Vascular Plant Systematics. Harper and Row, New York. 891 pp.
- Ruffner, J.A. 1980. Climates of the United States: National Oceanic and Atmospheric Administration narrative summaries, tables, and maps for each state with overview of state climatologist programs, 2nd edition. Volume 2. Gale Research Company, Detroit, Michigan.
- Shingleton, L.C. and A. Watterson, Jr. 1979. Soil Survey of Atoka County, Oklahoma. U.S.D.A. Soil Conservation Service, Stillwater, Oklahoma. 151 pp.
- Taylor, R.J. and C.E.S. Taylor. 1994. An Annotated List of the Ferns, Fern Allies, Gymnosperms, and Flowering Plants of Oklahoma, 3rd. edition. Published by authors, Durant, Oklahoma. 133 pp.
- U.S.D.A. Natural Resources Conservation Service. 1992. Map of Major Land Resource Areas of Oklahoma. Stillwater, Oklahoma.
- U.S. Fish and Wildlife Service. 1996. Endangered and Threatened Wildlife and Plants, October 31, 1996, 50 CFR 17.11-17.12, Washington, D.C. 46 pp.
- Waterfall, U.T. 1969. Keys to the Flora of Oklahoma, 4th edition. Published by author, Stillwater, Oklahoma. 246 pp.

## APPENDICES



## APPENDIX A

### DELTA-CHARS

\*SHOW: Asteraceae of Oklahoma - character list. Revised  
25 January 1997.

#### \*CHARACTER LIST

- #1. heads <morphological form>/
  - 1. all alike/
  - 2. of 2 forms, staminate and pistillate different  
    <e.g., Ambrosia>/
  - 3. of 2 forms, staminate and pistillate similar  
    <e.g., Baccharis>/
- #2. heads <when all alike; number; if several to numerous, give  
    range of numbers> <MANDATORY>/
- #3. heads <when all alike; distinctive, general characters that  
    serve to distinguish the taxon>/
- #4. heads <when all alike; arrangement; add descriptors as  
    necessary> <MANDATORY>/
  - 1. solitary/
  - 2. in pairs/
  - 3. in cymes/
  - 4. in scorpioid cymes/
  - 5. in spikes/
  - 6. in racemes/
  - 7. in rounded panicles/
  - 8. in pyramidal panicles/
  - 9. in corymbs <flat-topped>/
  - 10. in glomerules/
  - 11. in fascicles/
  - 12. in clusters/
- #5. heads <when all alike; position on plant>/
  - 1. terminal/
  - 2. axillary/
- #6. heads <when all alike; aspect relative to peduncle>/
  - 1. held erect <e.g., Solidago rigida>/
  - 2. held horizontally <e.g., Silphium laciniatum>/
  - 3. held obliquely <e.g., Liatris>/
  - 4. pendulous <e.g., Ambrosia>/
- #7. heads <when all alike; secondary involucre>/
  - 1. surrounded by secondary involucres <e.g.,  
    Elephantopus>/
  - 2. not surrounded by secondary involucres <implicit>/
- #8. heads <when all alike; floret arrangement>  
    <MANDATORY>/
  - 1. with ray florets only/
  - 2. with disk florets only/
  - 3. with both ray and disk florets/
  - 4. with ligulate florets only <e.g., Lactuceae>/
- #9. heads <when all alike; width>/  
    mm wide/
- #10. heads <when all alike; length>/  
    mm long/
- #11. primary peduncles <of heads when all alike; axis  
    terminating in a compound inflorescence of heads or  
    when heads solitary; presence>/
  - 1. present <implicit>/
  - 2. absent/
- #12. primary peduncles <of heads when all alike; axis  
    terminating in a compound inflorescence of heads or  
    when heads solitary; distinctive general characters that  
    serve to distinguish the taxon>/
- #13. primary peduncles <of heads when all alike; axis  
    terminating in a compound inflorescence of heads or  
    when heads solitary; length>/  
    cm long/
- #14. secondary peduncles <of heads when all alike; axis  
    terminating in a single head; presence>/
  - 1. present/
  - 2. absent/
- #15. secondary peduncles <of heads when all alike; axis  
    terminating in a single head; distinctive general  
    characters that serve to distinguish the taxon>/
- #16. secondary peduncles <of heads when all alike; axis  
    terminating in a single head; length>/  
    mm long/
- #17. phyllaries <presence>/
  - 1. present <implicit>/
  - 2. absent <e.g., Psilocarphus>/
- #18. phyllaries <morphological forms> <MANDATORY>/
  - 1. all alike/
  - 2. of 2 forms/
  - 3. of 3 forms/
  - 4. of 4 or more forms/
- #19. phyllaries <when all alike; number>/
  - 1. 1/
  - 2. 2/
  - 3. 3/
  - 4. 4/
  - 5. 5/
  - 6. 6/
  - 7. 7/
  - 8. 8/
  - 9. 9/
  - 10. 10/
  - 11. 12-20/
  - 12. 20-30/
  - 13. 30 or more/
- #20. phyllaries <when all alike; rows>/
  - 1. in 1 row/
  - 2. in 2 rows/
  - 3. in 3 rows <e.g., Zinnia>/
  - 4. in 4 rows <e.g., Rudbeckia>/
  - 5. in 5 rows/
  - 6. in 6 rows/
  - 7. in 7 or more rows <e.g., Aster patens>/

- #21. phyllaries <when all alike in 1 row; descriptive, general characters that serve to distinguish the taxon>/
- #22. phyllaries <when all alike in 1 row; persistence>/
1. caducous/
  2. deciduous/
  3. persistent <implicit>/
- #23. phyllaries <when all alike in 1 row; imbricate>/
1. imbricate/
  2. not imbricate/
- #24. phyllaries <when all alike in 1 row; fusion>/
1. free/
  2. fused/
  3. fused at bases/
  4. fused, forming a bur/
  5. fused, forming a spiny bur/
- #25. phyllaries <when all alike in 1 row; aspect>/
1. appressed/
  2. ascending/
  3. spreading/
  4. reflexed/
  5. curled/
  6. deflexed/
- #26. phyllaries <when all alike in 1 row; specific color or colors that serves to distinguish the taxon>/
- #27. phyllaries <when all alike in 1 row; texture>/
1. fleshy/
  2. succulent/
  3. cartilaginous <hard and tough, but flexible>/
  4. chartaceous <papery, opaque and thin>/
  5. coriaceous <leathery>/
  6. fibrous <having loose, woody strands>/
  7. flaccid <lax and weak>/
  8. herbaceous <soft and succulent>/
  9. hyaline <thin and translucent or transparent>/
  10. indurate <hardened>/
  11. membranous <thin and semi-transparent>/
  12. scarious <thin and dry>/
  13. spongy <cellular, sponge-like>/
  14. subherbaceous/
  15. foliaceous <leaf-like>/
- #28. phyllaries <when all alike in 1 row; shape>/
1. subulate/
  2. acicular/
  3. filiform/
  4. linear/
  5. lanceolate/
  6. oblanceolate/
  7. ovate/
  8. obovate/
  9. elliptic/
  10. oblong/
  11. spatulate/
  12. runcinate/
  13. pandurate/
  14. deltoid/
  15. obdeltoid/
  16. cordate/
  17. obcordate/
  18. reniform/
  19. sagittate/
  20. flabellate/
  21. orbicular/
  22. oval/
  23. ensiform/
  24. squarrose/
  25. concave/
- #29. phyllaries <when all alike in 1 row; width>/
- mm wide/
- #30. phyllaries <when all alike in 1 row; length>/
- mm long/
- #31. phyllaries <when all alike in 1 row; surface>/
1. smooth/
  2. glaucous <waxy covering>/
  3. echinate <stout prickles>/
  4. farinaceous <mealy covering>/
  5. glandular <covered with secretory structures>/
  6. muricate <short, hard protuberances, bumpy>/
  7. resinous <yellowish, sticky exudate>/
  8. scabrous <roughened by short, pointed projections>/
  9. scurfy <mealy; small bran-like scales>/
  10. tuberculate <warty, small swellings>/
  11. punctate <dented; pitted; minute impressions or depressions>/
  12. pulverulent <dusty or powdery>/
  13. rugose <wrinkled or venation impressed in the surface>/
  14. sulcate <longitudinal grooves>/
  15. winged <flat extension>/
  16. alveolate <pitted surface with pits separated by thin partitions; honey-combed>/
  17. ridged/
  18. ribbed/
  19. pustulate <minute blisters>/
  20. striate <longitudinal blisters>/
- #32. venation <of phyllaries when all alike in 1 row; conspicuousness>/
1. not apparent/
  2. inconspicuous/
  3. conspicuous/
- #33. venation <of phyllaries when all alike in 1 row; number>/
1. of 1 vein/
  2. of 2 veins/
  3. of 3 veins/
  4. of 4 or more veins/
- #34. venation <of phyllaries when all alike in 1 row; distinctive, general characters that serve to distinguish the Taxon>/
- #35. indumentum <of phyllaries when all alike in 1 row>/
1. glabrous/
  2. scabrous <rough to the touch with short, hard, rigid trichomes>/
  3. scaberulous <minutely scabrous>/
  4. pubescent <soft, short, dense trichomes>/
  5. puberulent <minutely pubescent>/
  6. velutinous <soft, short, dense, straight trichomes; velvety>/
  7. tomentose <soft, short, dense, matted trichomes>/
  8. villous <soft, long, dense, curly, ascending trichomes>/
  9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/
  10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/
  11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/
  12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/
  13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/
  14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/
  15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/
  16. with glandular trichomes/
  17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/
  18. with barbed trichomes/
- #36. apices <of phyllaries when all alike in 1 row; shape>/
1. aristate/
  2. caudate/
  3. acuminate/
  4. acute/
  5. cuspidate/
  6. mucronate/
  7. mucronulate/
  8. apiculate/

9. obtuse/
  10. retuse/
  11. emarginate/
  12. attenuate/
  13. obcordate/
  14. truncate/
  15. rounded/
  16. hooked/
  17. spine-tipped/
- #37. apices <of phyllaries when all alike in 1 row; distinctive, general characters that serve to distinguish the taxon>/
- #38. margins <of phyllaries when all alike in 1 row; distinctive, general characters that serve to distinguish the taxon>/
- #39. margins <of phyllaries when all alike in 1 row>/
1. with fimbriate-ciliate appendages/
  2. with lacerate appendages <e.g., Centaurea>/
  3. with variously shaped appendages <describe>/
- #40. margins <of phyllaries when all alike in 1 row; specific color or colors that serves to distinguish the taxon>/
- #41. margins <of phyllaries when all alike in 1 row>/
1. entire/
  2. undulate/
  3. sinuate/
  4. crenate/
  5. crenulate/
  6. erose/
  7. serrate/
  8. doubly serrate/
  9. serrulate/
  10. dentate/
  11. denticulate/
  12. incised/
  13. lacerate/
  14. lacinate/
  15. crispate/
  16. ciliate/
  17. spinose/
  18. scarious/
  19. membranous/
- #42. bases <of phyllaries when all alike in 1 row; distinctive, general characters that serve to distinguish the taxon>/
- #43. bases <of phyllaries when all alike in 1 row; shape>/
1. gibbous <e.g., Pectis>/
  2. not gibbous/
- #44. bases <of phyllaries when all alike in 1 row; shape>/
1. keeled <e.g., Pectis>/
  2. not keeled/
- #45. bases <of phyllaries when all alike in 1 row; enclosure of outermost achenes>/
1. enclosing outermost achenes/
  2. not enclosing outermost achenes/
- #46. outer phyllaries <when all alike in 2 or more rows; number>/
1. 1/
  2. 2/
  3. 3/
  4. 4/
  5. 5/
  6. 6/
  7. 7/
  8. 8/
  9. 9/
  10. 10/
  11. 12 -20/
  12. 20-30/
  13. 30 or more/
- #47. outer phyllaries <when all alike in 2 or more rows; distinctive general characters that serve to distinguish the taxon>/
- #48. outer phyllaries <when all alike in 2 or more rows; persistence>/
1. caducous/
  2. deciduous/
  3. persistent <implicit>/
- #49. outer phyllaries <when all alike in 2 or more rows; imbricate>/
1. imbricate/
  2. not imbricate/
- #50. outer phyllaries <when all alike in 2 or more rows; fusion>/
1. free/
  2. fused/
  3. fused at bases/
- #51. outer phyllaries <when all alike in 2 or more rows; aspect>/
1. appressed/
  2. ascending/
  3. spreading/
  4. reflexed/
  5. curled/
  6. deflexed/
- #52. outer phyllaries <when all alike in 2 or more rows; specific color or colors that serves to distinguish the taxon>/
- #53. outer phyllaries <when all alike in 2 or more rows; texture>/
1. fleshy/
  2. succulent/
  3. cartilaginous <hard and tough, but flexible>/
  4. chartaceous <papery, opaque and thin>/
  5. coriaceous <leathery>/
  6. fibrous <having loose, woody strands>/
  7. flaccid <lax and weak>/
  8. herbaceous <soft and succulent>/
  9. hyaline <thin and translucent or transparent>/
  10. indurate <hardened>/
  11. membranous <thin and semi-transparent>/
  12. scarious <thin and dry>/
  13. spongy <cellular, sponge-like>/
  14. subherbaceous/
  15. foliaceous <leaf-like>/
- #54. outer phyllaries <when all alike in 2 or more rows; shape>/
1. subulate/
  2. acicular/
  3. filiform/
  4. linear/
  5. lanceolate/
  6. oblanceolate/
  7. ovate/
  8. obovate/
  9. elliptic/
  10. oblong/
  11. spathulate/
  12. runcinate/
  13. pandurate/
  14. deltoid/
  15. obdeltoid/
  16. cordate/
  17. obcordate/
  18. reniform/
  19. sagittate/
  20. flabellate/
  21. orbicular/
  22. oval/
  23. ensiform/
  24. squarrose/
  25. concave/
- #55. outer phyllaries <when all alike in 2 or more rows; width>/

- mm wide/
- #56. outer phyllaries <when all alike in 2 or more rows; length>/  
mm long/
- #57. outer phyllaries <when all alike in 2 or more rows; surface>/
1. smooth/
  2. glaucous <waxy covering>/
  3. echinate <stout prickles>/
  4. farinaceous <mealy covering>/
  5. glandular <covered with secretory structures>/
  6. muricate <short, hard protuberances, bumpy>/
  7. resinous <yellowish, sticky exudate>/
  8. scabrous <roughened by short, pointed projections>/
  9. scurfy <mealy; small bran-like scales>/
  10. tuberculate <warty, small swellings>/
  11. punctate <dented; pitted; minute impressions or depressions>/
  12. pulverulent <dusty or powdery>/
  13. rugose <wrinkled or venation impressed inot the surface>/
  14. sulcate <longitudinal grooves>/
  15. winged <flat extension>/
  16. alveolate <pitted surface with pits separated by thin partitions; honey-comed>/
  17. ridged/
  18. ribbed/
  19. pustulate <minute blisters>/
  20. striate <longitudinal blisters>/
- #58. venation <of outer phyllaries when all alike in 2 or more rows; conspicuousness>/
1. not apparent/
  2. inconspicuous/
  3. conspicuous/
- #59. venation <of outer phyllaries when all alike in 2 or more rows; number>/
1. of 1 vein/
  2. of 2 veins/
  3. of 3 veins/
  4. of 4 or more veins/
- #60. venation <of outer phyllaries when all alike in 2 or more rows; distinctive, general characters that serve to distinguish the taxon>/
- #61. indumentum <of outer phyllaries when all alike in 2 or more rows>/
1. glabrous/
  2. scabrous <rough to the touch with short, hard, rigid trichomes>/
  3. scaberulous <minutely scabrous>/
  4. pubescent <soft, short, dense trichomes>/
  5. puberulent <minutely pubescent>/
  6. velutinous <soft, short, dense, straight trichomes; velvety>/
  7. tomentose <soft, short, dense, matted trichomes>/
  8. villous <soft, long, dense, curly, ascending trichomes>/
  9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/
  10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/
  11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/
  12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/
  13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/
  14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/
  15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/
  16. with glandular trichomes/
  17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/
  18. with barbed trichomes/
- #62. apices <of outer phyllaries when all alike in 2 or more rows; shape>/
1. aristate/
  2. caudate/
  3. acuminate/
  4. acute/
  5. cuspidate/
  6. mucronate/
  7. mucronulate/
  8. apiculate/
  9. obtuse/
  10. retuse/
  11. emarginate/
  12. attenuate/
  13. obcordate/
  14. truncate/
  15. rounded/
  16. hooked/
  17. spine-tipped/
- #63. apices <of outer phyllaries when all alike in 2 or more rows; distinctive, general characters that serve to distinguish the taxon>/
- #64. margins <of outer phyllaries when all alike in 2 or more rows; distinctive, general characters that serve to distinguish the taxon>/
- #65. margins <of outer phyllaries when all alike in 2 or more rows>/
1. with fimbriate-ciliate appendages/
  2. with lacerate appendages <e.g., Centaurea>/
  3. with variously shaped appendages <describe>/
- #66. margins <of outer phyllaries when all alike in 2 or more rows; specific color or colors that serves to distinguish the taxon>/
- #67. margins <of outer phyllaries when all alike in 2 or more rows>/
1. entire/
  2. undulate/
  3. sinuate/
  4. crenate/
  5. crenulate/
  6. erose/
  7. serrate/
  8. doubly serrate/
  9. serrulate/
  10. dentate/
  11. denticulate/
  12. incised/
  13. lacerate/
  14. laciniate/
  15. crispate/
  16. ciliate/
  17. spinose/
  18. scarious/
  19. membranous/
- #68. bases <of outer phyllaries when all alike in 2 or more rows; distinctive, general characters that serve to distinguish the taxon>/
- #69. bases <of outer phyllaries when all alike in 2 or more rows; shape>/
1. gibbous <e.g., Pectis>/
  2. not gibbous/
- #70. bases <of outer phyllaries when all alike in 2 or more rows; shape>/
1. keeled <e.g., Pectis>/
  2. not keeled/
- #71. inner phyllaries <when all alike in 2 or more rows; number>/
1. 1/
  2. 2/
  3. 3/
  4. 4/
  5. 5/

6. 6/
  7. 7/
  8. 8/
  9. 9/
  10. 10/
  11. 12 -20/
  12. 20-30/
  13. 30 or more/
- #72. inner phyllaries <when all alike in 2 or more rows; distinctive general characters that serve to distinguish the taxon>/
- #73. inner phyllaries <when all alike in 2 or more rows; persistence>/
1. caducous/
  2. deciduous/
  3. persistent <implicit>/
- #74. inner phyllaries <when all alike in 2 or more rows; imbricate>/
1. imbricate/
  2. not imbricate/
- #75. inner phyllaries <when all alike in 2 or more rows; fusion>/
1. free/
  2. fused/
  3. fused at bases/
- #76. inner phyllaries <when all alike in 2 or more rows; aspect>/
1. appressed/
  2. ascending/
  3. spreading/
  4. reflexed/
  5. curled/
  6. deflexed/
- #77. inner phyllaries <when all alike in 2 or more rows; specific color or colors that serves to distinguish the taxon>/
- #78. inner phyllaries <when all alike in 2 or more rows; texture>/
1. fleshy/
  2. succulent/
  3. cartilaginous <hard and tough, but flexible>/
  4. chartaceous <papery, opaque and thin>/
  5. coriaceous <leathery>/
  6. fibrous <having loose, woody strands>/
  7. flaccid <lax and weak>/
  8. herbaceous <soft and succulent>/
  9. hyaline <thin and translucent or transparent>/
  10. indurate <hardened>/
  11. membranous <thin and semi-transparent>/
  12. scarious <thin and dry>/
  13. spongy <cellular, sponge-like>/
  14. subherbaceous/
  15. foliaceous <leaf-like>/
- #79. inner phyllaries <when all alike in 2 or more rows; shape>/
1. subulate/
  2. acicular/
  3. filiform/
  4. linear/
  5. lanceolate/
  6. oblanceolate/
  7. ovate/
  8. obovate/
  9. elliptic/
  10. oblong/
  11. spatulate/
  12. runcinate/
  13. pandurate/
  14. deltoid/
  15. obdeltoid/
  16. cordate/
  17. obcordate/
  18. reniform/
19. sagittate/
  20. flabellate/
  21. orbicular/
  22. oval/
  23. ensiform/
  24. squarrose/
  25. concave/
- #80. inner phyllaries <when all alike in 2 or more rows; width>/
- mm wide/
- #81. inner phyllaries <when all alike in 2 or more rows; length>/
- mm long/
- #82. inner phyllaries <when all alike in 2 or more rows; surface>/
1. smooth/
  2. glaucous <waxy covering>/
  3. echinate <stout prickles>/
  4. farinaceous <mealy covering>/
  5. glandular <covered with secretory structures>/
  6. muricate <short, hard protuberances, bumpy>/
  7. resinous <yellowish, sticky exudate>/
  8. scabrous <roughened by short, pointed projections>/
  9. scurfy <mealy; small bran-like scales>/
  10. tuberculate <warty, small swellings>/
  11. punctate <dented; pitted; minute impressions or depressions>/
  12. pulverulent <dusty or powdery>/
  13. rugose <wrinkled or venation impressed inot the surface>/
  14. sulcate <longitudinal grooves>/
  15. winged <flat extension>/
  16. alveolate <pitted surface with pits separated by thin partitions; honey-comed>/
  17. ridged/
  18. ribbed/
  19. pustulate <minute blisters>/
  20. striate <longitudinal blisters>/
- #83. venation <of inner phyllaries when all alike in 2 or more rows; conspicuousness>/
1. not apparent/
  2. inconspicuous/
  3. conspicuous/
- #84. venation <of inner phyllaries when all alike in 2 or more rows; number>/
1. of 1 vein/
  2. of 2 veins/
  3. of 3 veins/
  4. of 4 or more veins/
- #85. venation <of inner phyllaries when all alike in 2 or more rows; distinctive, general characters that serve to distinguish the taxon>/
- #86. indumentum <of inner phyllaries when all alike in 2 or more rows>/
1. glabrous/
  2. scabrous <rough to the touch with short, hard, rigid trichomes>/
  3. scaberulous <minutely scabrous>/
  4. pubescent <soft, short, dense trichomes>/
  5. puberulent <minutely pubescent>/
  6. velutinous <soft, short, dense, straight trichomes; velvety>/
  7. tomentose <soft, short, dense, matted trichomes>/
  8. villous <soft, long, dense, curly, ascending trichomes>/
  9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/
  10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/
  11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/
  12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/
  13. hirsute <stiff, long, dense or sparse, erect or

- ascending, straight trichomes>/
14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/
15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/
16. with glandular trichomes/
17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/
18. with barbed trichomes/
- #87. apices <of inner phyllaries when all alike in 2 or more rows; shape>/
1. aristate/
  2. caudate/
  3. acuminate/
  4. acute/
  5. cuspidate/
  6. mucronate/
  7. mucronulate/
  8. apiculate/
  9. obtuse/
  10. retuse/
  11. emarginate/
  12. attenuate/
  13. obcordate/
  14. truncate/
  15. rounded/
  16. hooked/
  17. spine-tipped/
- #88. apices <of inner phyllaries when all alike in 2 or more rows; distinctive, general characters that serve to distinguish the taxon>/
- #89. margins <of inner phyllaries when all alike in 2 or more rows; distinctive, general characters that serve to distinguish the taxon>/
- #90. margins <of inner phyllaries when all alike in 2 or more rows>/
1. with fimbriate-ciliate appendages/
  2. with lacerate appendages <e.g., Centaurea>/
  3. with variously shaped appendages <describe>/
- #91. margins <of inner phyllaries when all alike in 2 or more rows; specific color or colors that serves to distinguish the taxon>/
- #92. margins <of inner phyllaries when all alike in 2 or more rows>/
1. entire/
  2. undulate/
  3. sinuate/
  4. crenate/
  5. crenulate/
  6. erose/
  7. serrate/
  8. doubly serrate/
  9. serrulate/
  10. dentate/
  11. denticulate/
  12. incised/
  13. lacerate/
  14. lacinate/
  15. crispate/
  16. ciliate/
  17. spinose/
  18. scarious/
  19. membranous/
- #93. bases <of inner phyllaries when all alike in 2 or more rows; distinctive, general characters that serve to distinguish the taxon>/
- #94. bases <of inner phyllaries when all alike in 2 or more rows; shape>/
1. gibbous <e.g., Pectis>/
  2. not gibbous/
- #95. bases <of inner phyllaries when all alike in 2 or more rows; shape>/
1. keeled <e.g., Pectis>/
  2. not keeled/
- #96. bases <of inner phyllaries when all alike in 2 or more rows; enclosure of outermost achenes>/
1. enclosing outermost achenes/
  2. not enclosing outermost achenes/
- #97. outer phyllaries <when of 2 or more forms; number>/
1. 1/
  2. 2/
  3. 3/
  4. 4/
  5. 5/
  6. 6/
  7. 7/
  8. 8/
  9. 9/
  10. 10/
  11. 12 -20/
  12. 20-30/
  13. 30 or more/
- #98. outer phyllaries <when of 2 or more forms; distinctive, general characters that serve to distinguish the taxon>/
- #99. outer phyllaries <when of 2 or more forms; persistence>/
1. caducous/
  2. deciduous/
  3. persistent <implicit>/
- #100. outer phyllaries <when of 2 or more forms; imbricate>/
1. imbricate/
  2. not imbricate/
- #101. outer phyllaries <when of 2 or more forms; fusion>/
1. free/
  2. fused/
  3. fused at bases/
- #102. outer phyllaries <when of 2 or more forms; aspect>/
1. appressed/
  2. ascending/
  3. spreading/
  4. reflexed/
  5. curled/
  6. deflexed/
- #103. outer phyllaries <when of 2 or more forms; specific color or colors that serves to distinguish the taxon>/
- #104. outer phyllaries <when of 2 or more forms; texture>/
1. fleshy/
  2. succulent/
  3. cartilaginous <hard and tough, but flexible>/
  4. chartaceous <papery, opaque and thin>/
  5. coriaceous <leathery>/
  6. fibrous <having loose, woody strands>/
  7. flaccid <lax and weak>/
  8. herbaceous <soft and succulent>/
  9. hyaline <thin and translucent or transparent>/
  10. indurate <hardened>/
  11. membranous <thin and semi-transparent>/
  12. scarious <thin and dry>/
  13. spongy <cellular, sponge-like>/
  14. subherbaceous/
  15. foliaceous <leaf-like>/
- #105. outer phyllaries <when of 2 or more forms; shape>/
1. subulate/
  2. acicular/
  3. filiform/
  4. linear/
  5. lanceolate/
  6. oblanceolate/
  7. ovate/
  8. obovate/
  9. elliptic/
  10. oblong/
  11. spatulate/
  12. runcinate/

13. pandurate/
  14. deltoid/
  15. obdeltoid/
  16. cordate/
  17. obcordate/
  18. reniform/
  19. sagittate/
  20. flabellate/
  21. orbicular/
  22. oval/
  23. ensiform/
  24. squarrose/
  25. concave/
- #106. outer phyllaries <when of 2 or more forms; width>/  
mm wide/
- #107. outer phyllaries <when of 2 or more forms; length>/  
mm long/
- #108. outer phyllaries <when of 2 or more forms; surface>/  
  1. smooth/
  2. glaucous <waxy covering>/
  3. echinate <stout prickles>/
  4. farinaceous <mealy covering>/
  5. glandular <covered with secretory structures>/
  6. muricate <short, hard protuberances, bumpy>/
  7. resinous <yellowish, sticky exudate>/
  8. scabrous <roughened by short, pointed projections>/
  9. scurfy <mealy; small bran-like scales>/
  10. tuberculate <warty, small swellings>/
  11. punctate <dented; pitted; minute impressions or depressions>/
  12. pulverulent <dusty or powdery>/
  13. rugose <wrinkled or venation impressed inot the surface>/
  14. sulcate <longitudinal grooves>/
  15. winged <flat extension>/
  16. alveolate <pitted surface with pits separated by thin partitions; honey-comed>/
  17. ridged/
  18. ribbed/
  19. pustulate <minute blisters>/
  20. striate <longitudinal blisters>/
- #109. venation <of outer phyllaries when of 2 or more forms; conspicuousness>/  
  1. not apparent/
  2. inconspicuous/
  3. conspicuous/
- #110. venation <of outer phyllaries when of 2 or more forms; number>/  
  1. of 1 vein/
  2. of 2 veins/
  3. of 3 veins/
  4. of 4 or more veins/
- #111. venation <of outer phyllaries when of 2 or more forms; distinctive, general characters that serve to distinguish the taxon>/
- #112. indumentum <of outer phyllaries when of 2 or more forms>/  
  1. glabrous/
  2. scabrous <rough to the touch with short, hard, rigid trichomes>/
  3. scaberulous <minutely scabrous>/
  4. pubescent <soft, short, dense trichomes>/
  5. puberulent <minutely pubescent>/
  6. velutinous <soft, short, dense, straight trichomes; velvety>/
  7. tomentose <soft, short, dense, matted trichomes>/
  8. villous <soft, long, dense, curly, ascending trichomes>/
  9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/
  10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/
  11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/
  12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/
13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/
14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/
15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/
16. with glandular trichomes/
17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/
18. with barbed trichomes/
- #113. apices <of outer phyllaries when of 2 or more forms; shape>/  
  1. aristate/
  2. caudate/
  3. acuminate/
  4. acute/
  5. cuspidate/
  6. mucronate/
  7. mucronulate/
  8. apiculate/
  9. obtuse/
  10. retuse/
  11. emarginate/
  12. attenuate/
  13. obcordate/
  14. truncate/
  15. rounded/
  16. hooked/
  17. spine-tipped/
- #114. apices <of outer phyllaries when of 2 or more forms; distinctive, general characters that serve to distinguish the taxon>/
- #115. margins <of outer phyllaries when of 2 or more forms; distinctive, general characters that serve to distinguish the taxon>/
- #116. margins <of outer phyllaries when of 2 or more forms>/  
  1. with fimbriate-ciliate appendages/
  2. with lacerate appendages <e.g., Centaurea>/
  3. with variously shaped appendages <describe>/
- #117. margins <of outer phyllaries when of 2 or more forms; specific color or colors that serves to distinguish the taxon>/
- #118. margins <of outer phyllaries when of 2 or more forms>/  
  1. entire/
  2. undulate/
  3. sinuate/
  4. crenate/
  5. crenulate/
  6. erose/
  7. serrate/
  8. doubly serrate/
  9. serrulate/
  10. dentate/
  11. denticulate/
  12. incised/
  13. lacerate/
  14. lacinate/
  15. crispate/
  16. ciliate/
  17. spinose/
  18. scarious/
  19. membranous/
- #119. bases <of outer phyllaries when of 2 or more forms; distinctive, general characters that serve to distinguish the taxon>/
- #120. bases <of outer phyllaries when of 2 or more forms; shape>/  
  1. gibbous <e.g., Pectis>/
  2. not gibbous/
- #121. bases <of outer phyllaries when of 2 or more forms; shape>/

1. keeled <e.g., Pectis>/
  2. not keeled/
- #122. inner phyllaries <when of 2 or more forms; number>/
1. 1/
  2. 2/
  3. 3/
  4. 4/
  5. 5/
  6. 6/
  7. 7/
  8. 8/
  9. 9/
  10. 10/
  11. 12 -20/
  12. 20-30/
  13. 30 or more/
- #123. inner phyllaries <when of 2 or more forms; distinctive, general characters that serve to distinguish the taxon>/
- #124. inner phyllaries <when of 2 or more forms; persistence>/
1. caducous/
  2. deciduous/
  3. persistent <implicit>/
- #125. inner phyllaries <when of 2 or more forms; imbricate>/
1. imbricate/
  2. not imbricate/
- #126. inner phyllaries <when of 2 or more forms; fusion>/
1. free/
  2. fused/
  3. fused at bases/
- #127. inner phyllaries <when of 2 or more forms; aspect>/
1. appressed/
  2. ascending/
  3. spreading/
  4. reflexed/
  5. curled/
  6. deflexed/
- #128. inner phyllaries <when of 2 or more forms; specific color or colors that serves to distinguish the taxon>/
- #129. inner phyllaries <when of 2 or more forms; texture>/
1. fleshy/
  2. succulent/
  3. cartilaginous <hard and tough, but flexible>/
  4. chartaceous <papery, opaque and thin>/
  5. coriaceous <leathery>/
  6. fibrous <having loose, woody strands>/
  7. flaccid <lax and weak>/
  8. herbaceous <soft and succulent>/
  9. hyaline <thin and translucent or transparent>/
  10. indurate <hardened>/
  11. membranous <thin and semi-transparent>/
  12. scarious <thin and dry>/
  13. spongy <cellular, sponge-like>/
  14. subherbaceous/
  15. foliaceous <leaf-like>/
- #130. inner phyllaries <when of 2 or more forms; shape>/
1. subulate/
  2. acicular/
  3. filiform/
  4. linear/
  5. lanceolate/
  6. oblanceolate/
  7. ovate/
  8. obovate/
  9. elliptic/
  10. oblong/
  11. spatulate/
  12. runcinate/
  13. pandurate/
  14. deltoid/
  15. obdeltoid/
  16. cordate/
  17. obcordate/
18. reniform/
  19. sagittate/
  20. flabellate/
  21. orbicular/
  22. oval/
  23. ensiform/
  24. squarrose/
  25. concave/
- #131. inner phyllaries <when of 2 or more forms; width>/
- mm wide/
- #132. inner phyllaries <when of 2 or more forms; length>/
- mm long/
- #133. inner phyllaries <when of 2 or more forms; surface>/
1. smooth/
  2. glaucous <waxy covering>/
  3. echinate <stout prickles>/
  4. farinaceous <mealy covering>/
  5. glandular <covered with secretory structures>/
  6. muricate <short, hard protuberances, bumpy>/
  7. resinous <yellowish, sticky exudate>/
  8. scabrous <roughened by short, pointed projections>/
  9. scurfy <mealy; small bran-like scales>/
  10. tuberculate <warty, small swellings>/
  11. punctate <dented; pitted; minute impressions or depressions>/
  12. pulverulent <dusty or powdery>/
  13. rugose <wrinkled or venation impressed in the surface>/
  14. sulcate <longitudinal grooves>/
  15. winged <flat extension>/
  16. alveolate <pitted surface with pits separated by thin partitions; honey-combed>/
  17. ridged/
  18. ribbed/
  19. pustulate <minute blisters>/
  20. striate <longitudinal blisters>/
- #134. venation <of inner phyllaries when of 2 or more forms; conspicuousness>/
1. not apparent/
  2. inconspicuous/
  3. conspicuous/
- #135. venation <of inner phyllaries when of 2 or more forms; number>/
1. of 1 vein/
  2. of 2 veins/
  3. of 3 veins/
  4. of 4 or more veins/
- #136. venation <of inner phyllaries when of 2 or more forms; distinctive, general characters that serve to distinguish the taxon>/
- #137. indumentum <of inner phyllaries when of 2 or more forms>/
1. glabrous/
  2. scabrous <rough to the touch with short, hard, rigid trichomes>/
  3. scaberulous <minutely scabrous>/
  4. pubescent <soft, short, dense trichomes>/
  5. puberulent <minutely pubescent>/
  6. velutinous <soft, short, dense, straight trichomes; velvety>/
  7. tomentose <soft, short, dense, matted trichomes>/
  8. villous <soft, long, dense, curly, ascending trichomes>/
  9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/
  10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/
  11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/
  12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/
  13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/
  14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/



15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/
16. with glandular trichomes/
17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/
18. with barbed trichomes/
- #138. apices <of inner phyllaries when of 2 or more forms; shape>/
1. aristate/
  2. caudate/
  3. acuminate/
  4. acute/
  5. cuspidate/
  6. mucronate/
  7. mucronulate/
  8. apiculate/
  9. obtuse/
  10. retuse/
  11. emarginate/
  12. attenuate/
  13. obcordate/
  14. truncate/
  15. rounded/
  16. hooked/
  17. spine-tipped/
- #139. apices <of inner phyllaries when of 2 or more forms; distinctive, general characters that serve to distinguish the taxon>/
- #140. margins <of inner phyllaries when of 2 or more forms; distinctive, general characters that serve to distinguish the taxon>/
- #141. margins <of inner phyllaries when of 2 or more forms>/
1. with fimbriate-ciliate appendages/
  2. with lacerate appendages <e.g., Centaurea>/
  3. with variously shaped appendages <describe>/
- #142. margins <of inner phyllaries when of 2 or more forms; specific color or colors that serves to distinguish the taxon>/
- #143. margins <of inner phyllaries when of 2 or more forms>/
1. entire/
  2. undulate/
  3. sinuate/
  4. crenate/
  5. crenulate/
  6. erose/
  7. serrate/
  8. doubly serrate/
  9. serrulate/
  10. dentate/
  11. denticulate/
  12. incised/
  13. lacerate/
  14. laciniate/
  15. crispate/
  16. ciliate/
  17. spinose/
  18. scarious/
  19. membranous/
- #144. bases <of inner phyllaries when of 2 or more forms; distinctive, general characters that serve to distinguish the taxon>/
- #145. bases <of inner phyllaries when of 2 or more forms; shape>/
1. gibbous <e.g., Pectis>/
  2. not gibbous/
- #146. bases <of inner phyllaries when of 2 or more forms; shape>/
1. keeled <e.g., Pectis>/
  2. not keeled/
- #147. bases <of inner phyllaries when of 2 or more forms; enclosure of outermost achenes>/
1. enclosing outermost achenes/
  2. not enclosing outermost achenes/
- #148. ray florets <presence>/
1. present/
  2. absent/
- #149. ray florets <number>/
1. 2/
  2. 3/
  3. 4/
  4. 5/
  5. 6/
  6. 7/
  7. 8/
  8. 9/
  9. 10-20/
  10. 20 or more/
- #150. ray florets <distinctive, general characters that serve to distinguish the taxon>/
- #151. ray florets <rows>/
1. in 1 row/
  2. in 2 rows/
  3. in 3 or more rows/
- #152. ray florets <number per row, when in more than 1 whorl>/
- #153. ray florets <sexuality> <MANDATORY>/
1. perfect/
  2. pistillate/
  3. staminate/
  4. neuter/
  5. perfect, but functionally pistillate/
  6. perfect, but functionally staminate/
- #154. ray florets <fertility; producing achenes>/
1. fertile/
  2. sterile/
- #155. pappus <of ray florets; presence>/
1. absent/
  2. present; in 1 whorl/
  3. present; in 2 whorls <double>/
- #156. pappus <of ray florets when in 1 whorl; morphological forms>/
1. of awns/
  2. of scales/
  3. of teeth/
  4. of appressed teeth/
  5. of capillary hairs/
  6. of capillary bristles/
  7. of bristles/
  8. of scabrous bristles/
  9. of stiff bristles/
  10. of plumose bristles/
  11. coroniform/
  12. of barbellate bristles/
  13. of scarious scales/
  14. of smooth bristles/
  15. of hairs/
  16. an adaxial auricle <e.g., Anthemis>/
  17. of bristlelike scales/
  18. of stiff scales/
  19. of subclavate hairs/
  20. of subulate hairs <awl-shaped>/
  21. a crenulate rim <e.g., Heliopsis>/
  22. of barbellate awns/
  23. of retrorsely hispid awns/
  24. of fimbriate awns/
  25. of elongate awns/
  26. of serrulate awns/
- #157. pappus <of ray florets; number of parts>/
1. 1/
  2. 2/
  3. 3/
  4. 4/

5. 5/
  6. 6/
  7. 7/
  8. 8/
  9. 9/
  10. 10/
  11. 11/
  12. 12 or more/
  13. numerous <number, if countable>/
- #158. pappus <of ray florets when in 1 whorl; distinctive, general characters that serve to distinguish the taxon>/
- #159. pappus <of ray florets when in 1 whorl; persistence>/
1. caducous/
  2. persistent in fruit/
  3. not persistent in fruit/
- #160. pappus <of ray florets when in 1 whorl; fusion>/
1. free/
  2. fused/
  3. fused at bases/
- #161. pappus <of ray florets when in 1 whorl; aspect>/
1. appressed/
  2. ascending/
  3. spreading/
  4. reflexed/
  5. curled/
- #162. pappus <of ray florets when in 1 whorl; specific color or colors that serves to distinguish the taxon>/
- #163. pappus <of ray florets when in 1 whorl; nature>/
1. fragile/
  2. stout/
- #164. pappus <of ray florets when in 1 whorl; nature>/
1. slender/
  2. thick/
  3. flattened on outer sides <e.g., Brickellia>/
- #165. pappus <of ray florets when in 1 whorl; width>/
- mm wide/
- #166. pappus <of ray florets when in 1 whorl; equality in length>/
1. all equal in length/
  2. unequal in length/
- #167. pappus <of ray florets when in 1 whorl; length>/
- mm long/
- #168. indumentum <of pappus of ray florets when in 1 whorl>/
1. glabrous/
  2. scabrous <rough to the touch with short, hard, rigid trichomes>/
  3. scaberulous <minutely scabrous>/
  4. pubescent <soft, short, dense trichomes>/
  5. puberulent <minutely pubescent>/
  6. velutinous <soft, short, dense, straight trichomes; velvety>/
  7. tomentose <soft, short, dense, matted trichomes>/
  8. villous <soft, long, dense, curly, ascending trichomes>/
  9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/
  10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/
  11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/
  12. arachnoid <soft, very long, dense, thin, loosely entangled richomes; cobwebby>/
  13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/
  14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/
  15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/
  16. with glandular trichomes/
  17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/
18. with barbed trichomes/
- #169. apices <of pappus of ray florets when in 1 whorl; shape>/
1. rounded/
  2. obtuse/
  3. acute/
  4. acuminate/
- #170. apices <of pappus of ray florets when in 1 whorl>/
1. with midribs excurrent as awns/
  2. with midribs not excurrent as awns/
- #171. margins <of pappus of ray florets when in 1 whorl>/
1. entire/
  2. undulate/
  3. sinuate/
  4. crenate/
  5. crenulate/
  6. erose/
  7. serrate/
  8. doubly serrate/
  9. serrulate/
  10. dentate/
  11. denticulate/
  12. incised/
  13. lacerate/
  14. laciniate/
  15. crispate/
  16. ciliate/
  17. spinose/
  18. scarious/
  19. membranous/
- #172. bases <of pappus of ray florets when in 1 whorl; nature>/
1. wide/
  2. narrow/
- #173. bases <of pappus of ray florets when in 1 whorl; nature>/
1. thick/
  2. thin/
- #174. bases <of pappus of ray florets when in 1 whorl; nature>/
1. straight/
  2. curved/
- #175. outer pappus <of ray florets when in 2 whorls; morphological forms>/
1. of awns/
  2. of scales/
  3. of teeth/
  4. of appressed teeth/
  5. of capillary hairs/
  6. of capillary bristles/
  7. of bristles/
  8. of scabrous bristles/
  9. of stiff bristles/
  10. of plumose bristles/
  11. coroniform/
  12. of barbellate bristles/
  13. of scarious scales/
  14. of smooth bristles/
  15. of hairs/
  16. an adaxial auricle <e.g., Anthemis>/
  17. of bristlelike scales/
  18. of stiff scales/
  19. of subclavate hairs/
  20. of subulate hairs <awl-shaped>/
  21. a crenulate rim <e.g., Heliopsis>/
  22. of barbellate awns/
  23. of retrorsely hispid awns/
  24. of fimbriate awns/
  25. of elongate awns/
  26. of serrulate awns/
- #176. outer pappus <of ray florets when in 2 whorls; number of parts>/

1. 1/
  2. 2/
  3. 3/
  4. 4/
  5. 5/
  6. 6/
  7. 7/
  8. 8/
  9. 9/
  10. 10/
  11. 11/
  12. 12 or more/
  13. numerous <number, if countable>/
- #177. outer pappus <of ray florets when in 2 whorls; distinctive, general characters that serve to distinguish the taxon>/
- #178. outer pappus <of ray florets when in 2 whorls; persistence>/
1. caducous/
  2. persistent in fruit/
  3. not persistent in fruit/
- #179. outer pappus <of ray florets when in 2 whorls; fusion>/
1. free/
  2. fused/
  3. fused at bases/
- #180. outer pappus <of ray florets when in 2 whorls; aspect>/
1. appressed/
  2. ascending/
  3. spreading/
  4. reflexed/
  5. curled/
- #181. outer pappus <of ray florets when in 2 whorls; specific color or colors that serves to distinguish the taxon>/
- #182. outer pappus <of ray florets when in 2 whorls; nature>/
1. fragile/
  2. stout/
- #183. outer pappus <of ray florets when in 2 whorls; nature>/
1. slender/
  2. thick/
  3. flattened on outer sides <e.g., Brickellia>/
- #184. outer pappus <of ray florets when in 2 whorls; width>/
- mm wide/
- #185. outer pappus <of ray florets when in 2 whorls; equality in length>/
1. all equal in length/
  2. unequal in length/
- #186. outer pappus <of ray florets when in 2 whorls; length>/
- mm long/
- #187. indumentum <of outer pappus of ray florets when in 2 whorls>/
1. glabrous/
  2. scabrous <rough to the touch with short, hard, rigid trichomes>/
  3. scaberulous <minutely scabrous>/
  4. pubescent <soft, short, dense trichomes>/
  5. puberulent <minutely pubescent>/
  6. velutinous <soft, short, dense, straight trichomes; velvety>/
  7. tomentose <soft, short, dense, matted trichomes>/
  8. villous <soft, long, dense, curly, ascending trichomes>/
  9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/
  10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/
  11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/
  12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/
  13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/
  14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/
  15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/
  16. with glandular trichomes/
  17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/
  18. with barbed trichomes/
- #188. apices <of outer pappus of ray florets when in 2 whorls; shape>/
1. rounded/
  2. obtuse/
  3. acute/
  4. acuminate/
- #189. apices <of outer pappus of ray florets when in 2 whorls>/
1. with midribs excurrent as awns/
  2. midribs not excurrent as awns/
- #190. margins <of outer pappus of ray florets when in 2 whorls>/
1. entire/
  2. undulate/
  3. sinuate/
  4. crenate/
  5. crenulate/
  6. erose/
  7. serrate/
  8. doubly serrate/
  9. serrulate/
  10. dentate/
  11. denticulate/
  12. incised/
  13. lacerate/
  14. lacinate/
  15. crispate/
  16. ciliate/
  17. spinose/
  18. scarious/
  19. membranous/
- #191. bases <of outer pappus of ray florets when in 2 whorls; nature>/
1. wide/
  2. narrow/
- #192. bases <of outer pappus of ray florets when in 2 whorls; nature>/
1. thick/
  2. thin/
- #193. bases <of outer pappus of ray florets when in 2 whorls; nature>/
1. straight/
  2. curved/
- #194. inner pappus <of ray florets when in 2 whorls; morphological forms>/
1. of awns/
  2. of scales/
  3. of teeth/
  4. of appressed teeth/
  5. of capillary hairs/
  6. of capillary bristles/
  7. of bristles/
  8. of scabrous bristles/
  9. of stiff bristles/
  10. of plumose bristles/
  11. coroniform/
  12. of barbellate bristles/
  13. of scarious scales/
  14. of smooth bristles/
  15. of hairs/
  16. an adaxial auricle <e.g., Anthemis>/
  17. of bristlelike scales/
  18. of stiff scales/
  19. of subclavate hairs/
  20. of subulate hairs <awl-shaped>/
  21. a crenulate rim <e.g., Heliopsis>/

22. of barbellate awns/  
 23. of retrorsely hispid awns/  
 24. of fimbriate awns/  
 25. of elongate awns/  
 26. of serrulate awns/
- #195. inner pappus <of ray florets when in 2 whorls; number of parts>/  
 1. 1/  
 2. 2/  
 3. 3/  
 4. 4/  
 5. 5/  
 6. 6/  
 7. 7/  
 8. 8/  
 9. 9/  
 10. 10/  
 11. 11/  
 12. 12 or more/  
 13. numerous <number, if countable>/
- #196. inner pappus <of ray florets when in 2 whorls; distinctive, general characters that serve to distinguish the taxon>/
- #197. inner pappus <of ray florets when in 2 whorls; persistence>/  
 1. caducous/  
 2. persistent in fruit/  
 3. not persistent in fruit/
- #198. inner pappus <of ray florets when in 2 whorls; fusion>/  
 1. free/  
 2. fused/  
 3. fused at bases/
- #199. inner pappus <of ray florets when in 2 whorls; aspect>/  
 1. appressed/  
 2. ascending/  
 3. spreading/  
 4. reflexed/  
 5. curled/
- #200. inner pappus <of ray florets when in 2 whorls; specific color or colors that serves to distinguish the taxon>/
- #201. inner pappus <of ray florets when in 2 whorls; nature>/  
 1. fragile/  
 2. stout/
- #202. inner pappus <of ray florets when in 2 whorls; nature>/  
 1. slender/  
 2. thick/  
 3. flattened on outer sides <e.g., Brickellia>/
- #203. inner pappus <of ray florets when in 2 whorls; width>/  
 mm wide/
- #204. inner pappus <of ray florets when in 2 whorls; equality in length>/  
 1. all equal in length/  
 2. unequal in length/
- #205. inner pappus <of ray florets when in 2 whorls; length>/  
 mm long/
- #206. indumentum <of inner pappus of ray florets when in 2 whorls>/  
 1. glabrous/  
 2. scabrous <rough to the touch with short, hard, rigid trichomes>/  
 3. scaberulous <minutely scabrous>/  
 4. pubescent <soft, short, dense trichomes>/  
 5. puberulent <minutely pubescent>/  
 6. velutinous <soft, short, dense, straight trichomes; velvety>/  
 7. tomentose <soft, short, dense, matted trichomes>/  
 8. villous <soft, long, dense, curly, ascending trichomes>/  
 9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/
10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/  
 11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/  
 12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/  
 13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/  
 14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/  
 15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/  
 16. with glandular trichomes/  
 17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/  
 18. with barbed trichomes/
- #207. apices <of inner pappus of ray florets when in 2 whorls; shape>/  
 1. rounded/  
 2. obtuse/  
 3. acute/  
 4. acuminate/
- #208. apices <of inner pappus of ray florets when in 2 whorls>/  
 1. with midribs excurrent as awns/  
 2. with midribs not excurrent as awns/
- #209. margins <of inner pappus of ray florets when in 2 whorls>/  
 1. entire/  
 2. undulate/  
 3. sinuate/  
 4. crenate/  
 5. crenulate/  
 6. erose/  
 7. serrate/  
 8. doubly serrate/  
 9. serrulate/  
 10. dentate/  
 11. denticulate/  
 12. incised/  
 13. lacerate/  
 14. laciniate/  
 15. crispate/  
 16. ciliate/  
 17. spinose/  
 18. scarious/  
 19. membranous/
- #210. bases <of inner pappus of ray florets when in 2 whorls; nature>/  
 1. wide/  
 2. narrow/
- #211. bases <of inner pappus of ray florets when in 2 whorls; nature>/  
 1. thick/  
 2. thin/
- #212. bases <of inner pappus of ray florets when in 2 whorls; nature>/  
 1. straight/  
 2. curved/
- #213. corollas <of ray florets; distinctive, general characters that serve to distinguish the taxon>/
- #214. corollas <of ray florets; differentiation>/  
 1. differentiated into limbs and tubes <implicit>/  
 2. not differentiated, limbs absent and tubes present/  
 3. not differentiated, limbs present and tubes absent <e.g., Zinnia>/
- #215. corollas <of ray florets; fusion of lobes>/  
 1. not lobed/  
 2. 2-lobed/  
 3. shallowly 3-lobed/  
 4. deeply 3-lobed/  
 5. 4-lobed/

6. 5-lobed/
- #216. corollas <of ray florets; persistence>/  
 1. cauducous/  
 2. persistent at maturity/  
 3. deciduous at maturity/
- #217. corollas <of ray florets; aspect>/  
 1. erect/  
 2. ascending/  
 3. spreading/  
 4. reflexed/  
 5. curled/
- #218. corollas <of ray florets; specific color or colors that serves to distinguish the taxon>/
- #219. corollas <of ray floret; limb texture>/  
 1. membranous/  
 2. fleshy/  
 3. succulent/  
 4. cartilaginous <hard and tough, but flexible>/  
 5. chartaceous <papery, opaque and thin, e.g., Hymenoxys>/  
 6. coriaceous <leathery>/  
 7. flaccid <lax and weak>/  
 8. herbaceous <soft and succulent>/  
 9. hyaline <thin and translucent or transparent>/  
 10. indurate <hardened>/  
 11. scarious <thin and dry>/
- #220. corollas <of ray florets; limb shape>/  
 1. spatulate/  
 2. cucullate/  
 3. linear/  
 4. emarginate/  
 5. bifid/  
 6. rhomboid/  
 7. deltoid/  
 8. triangular/  
 9. ovate/  
 10. lanceolate/  
 11. oblanceolate/  
 12. obovate/  
 13. oblong/  
 14. orbicular/
- #221. corollas <of ray florets; width>/  
 mm wide/
- #222. corollas <of ray florets; length including length of tube>/  
 mm long/
- #223. corollas <of ray florets; venation>/  
 1. 3-veined/  
 2. 4-veined/  
 3. 5-veined/  
 4. many veined/
- #224. indumentum <of corollas of ray florets>/  
 1. glabrous/  
 2. scabrous <rough to the touch with short, hard, rigid trichomes>/  
 3. scaberulous <minutely scabrous>/  
 4. pubescent <soft, short, dense trichomes>/  
 5. puberulent <minutely pubescent>/  
 6. velutinous <soft, short, dense, straight trichomes; velvety>/  
 7. tomentose <soft, short, dense, matted trichomes>/  
 8. villous <soft, long, dense, curly, ascending trichomes>/  
 9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/  
 10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/  
 11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/  
 12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/  
 13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/  
 14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/
15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/  
 16. with glandular trichomes/  
 17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/  
 18. with barbed trichomes/
- #225. indumentation <of corollas of ray florets; description of indumentation and location that serves to distinguish the taxon>/
- #226. apices <of corolla lobes of ray florets; shape>/  
 1. rounded/  
 2. obtuse/  
 3. acute/  
 4. acuminate/
- #227. bases of corolla tubes <of ray florets; enlargement>/  
 1. not enlarged in fruit <implicit>/  
 2. slightly saccate in fruit <e.g., Achillea>/  
 3. swollen in fruit/
- #228. stamens <of ray florets; presence>/  
 1. present/  
 2. absent/
- #229. stamens <of ray florets; number>/  
 1. 3/  
 2. 4/  
 3. 5/
- #230. stamens <of ray florets; distinctive, general characters that serve to distinguish the taxon>/
- #231. stamens <of ray florets; length>/  
 mm long/
- #232. stamens <of ray florets; fusion>/  
 1. free/  
 2. fused by filaments/  
 3. fused by anthers <implicit>/
- #233. anthers <of ray florets; distinctive, general characteristics that serve to distinguish the taxon>/
- #234. anthers <of ray florets; specific color or colors that serves to distinguish the taxon>/
- #235. anthers <of ray florets; straightness>/  
 1. straight/  
 2. curved/
- #236. anthers <of ray florets; width>/  
 mm wide/
- #237. anthers <of ray florets; length>/  
 mm long/
- #238. apical appendages <of anthers of ray florets; presence>/  
 1. present/  
 2. absent/
- #239. apical appendages <of anthers of ray florets; appearance>/  
 1. flat/  
 2. keeled/  
 3. curved/
- #240. apical appendages <of anthers of ray florets; shape>/  
 1. linear/  
 2. lanceolate/  
 3. subulate/  
 4. spatulate/
- #241. apical appendages <of anthers of ray florets; width>/  
 mm wide/
- #242. apical appendages <of anthers of ray florets; length>/  
 mm long/

- #243. thecae <of anthers of ray florets; distinctive, general characteristics that serve to distinguish the taxon>/
- #244. bases <of anthers of ray florets; shape>/  
 1. obtuse/  
 2. subtruncate/  
 3. rounded/  
 4. sagittate/  
 5. caudate <tailed>/
- #245. connective tissue <of anthers of ray florets; distinctive, general characters that serve to distinguish the taxon>/
- #246. pollen <of ray florets; distinctive, general characters that serve to distinguish the taxon>/
- #247. filaments <of ray florets; distinctive, general characters that serve to distinguish the taxon>/
- #248. styles <of ray florets; presence>/  
 1. present <implicit>/  
 2. absent/
- #249. styles <of ray florets; distinctive, general characters that serve to distinguish the taxon>/
- #250. styles <of ray florets; division>/  
 1. divided/  
 2. not divided/
- #251. styles <of ray florets; describe degree of division if serves to distinguish the taxon>/
- #252. styles <of ray florets; length>/  
 mm long/
- #253. styles <of ray florets; length relative to corolla tubes>/  
 1. exerted beyond corolla tubes/  
 2. included within corolla tubes/  
 3. equalling corolla tubes/
- #254. style branches <of ray florets; presence>/  
 1. present/  
 2. absent/
- #255. style branches <of ray florets; distinctive, general characters that serve to distinguish the taxon>/
- #256. style branches <of ray florets; lobing>/  
 1. not lobed/  
 2. 2-lobed/
- #257. style branches <of ray florets; color or colors that serves to distinguish the taxon>/
- #258. style branches <of ray florets; shape>/  
 1. linear/  
 2. clavate/  
 3. filiform/  
 4. lanceolate/
- #259. style branches <of ray florets; organization of stigmatic regions>/  
 1. stigmatic regions on adaxial surfaces/  
 2. stigmatic regions forming 2 marginal bands/
- #260. indumentum <of style branches of ray florets>/  
 1. glabrous/  
 2. scabrous <rough to the touch with short, hard, rigid trichomes>/  
 3. scaberulous <minutely scabrous>/  
 4. pubescent <soft, short, dense trichomes>/  
 5. puberulent <minutely pubescent>/  
 6. velutinous <soft, short, dense, straight trichomes; velvety>/  
 7. tomentose <soft, short, dense, matted trichomes>/  
 8. villous <soft, long, dense, curly, ascending trichomes>/  
 9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/  
 10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/  
 11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/  
 12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/  
 13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/  
 14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/  
 15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/  
 16. with glandular trichomes/  
 17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/  
 18. with barbed trichomes/
- #261. sterile appendages <of style branches of ray florets; presence>/  
 1. present/  
 2. absent/
- #262. apices <of style branches of ray florets; shape>/  
 1. attenuate/  
 2. broadly rounded/  
 3. truncate/  
 4. obtuse/  
 5. acute/  
 6. acuminate/  
 7. triangular/
- #263. bases <of styles of ray florets; nature>/  
 1. swollen/  
 2. not swollen/  
 3. not swollen but with shaft enlarged/
- #264. bases <of styles of ray florets; nectaries>/  
 1. nectaries present/  
 2. nectaries absent/
- #265. indumentum <of bases of styles of ray florets>/  
 1. glabrous/  
 2. scabrous <rough to the touch with short, hard, rigid trichomes>/  
 3. scaberulous <minutely scabrous>/  
 4. pubescent <soft, short, dense trichomes>/  
 5. puberulent <minutely pubescent>/  
 6. velutinous <soft, short, dense, straight trichomes; velvety>/  
 7. tomentose <soft, short, dense, matted trichomes>/  
 8. villous <soft, long, dense, curly, ascending trichomes>/  
 9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/  
 10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/  
 11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/  
 12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/  
 13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/  
 14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/  
 15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/  
 16. with glandular trichomes/  
 17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/  
 18. with barbed trichomes/
- #266. sweeping hairs <on styles and style branches of ray florets; presence>/  
 1. present/  
 2. absent/
- #267. sweeping hairs <on styles and style branches of ray florets; arrangement>/  
 1. scattered abaxially along style branches and extending down shafts of styles <e.g., Vernonia>/  
 2. in ring on shafts below style branches <e.g., Cardus>/  
 3. concentrated on tips of style branches/  
 4. forming terminal truncate brushes on style branches

- <e.g., Senecio>/
- #268. sweeping hairs <on styles and style branches of ray florets; distinctive, general characters that serve to distinguish the taxon>/
- #269. achenes <of ray florets; presence>/  
1. present/  
2. absent/
- #270. achenes <of ray florets; distinctiveness>/  
1. vestigial/  
2. developed/
- #271. achenes <of ray florets; distinctive, general characters that serve to distinguish the taxon>/
- #272. achenes <of ray florets; color or colors that serves to distinguish the taxon>/
- #273. achenes <of ray florets; surface>/  
1. smooth/  
2. glandular/  
3. spiny/  
4. rugulose/  
5. setose <covered with bristles>/  
6. muricate/  
7. tuberculate/  
8. undulating/  
9. rugose/  
10. sulcate/  
11. striate/
- #274. achenes <of ray florets; shape in cross-section >/  
1. angular/  
2. terete/  
3. trigonous/  
4. tetragonous/  
5. pentagonous/  
6. flattened/  
7. lenticular/
- #275. achenes <of ray florets; shape in longitudinal-section>/  
1. columnar/  
2. conical/  
3. fusiform/  
4. ovate/  
5. oblong/  
6. obconical/  
7. elliptic/  
8. obovate/  
9. oblanceolate/  
10. lanceolate/  
11. linear/  
12. clavate/  
13. cylindrical/
- #276. achenes <of ray florets; width>/  
mm wide/
- #277. achenes <of ray florets; length>/  
mm long/
- #278. indumentum <of achenes of ray florets>/  
1. glabrous/  
2. scabrous <rough to the touch with short, hard, rigid trichomes>/  
3. scaberulous <minutely scabrous>/  
4. pubescent <soft, short, dense trichomes>/  
5. puberulent <minutely pubescent>/  
6. velutinous <soft, short, dense, straight trichomes; velvety>/  
7. tomentose <soft, short, dense, matted trichomes>/  
8. villous <soft, long, dense, curly, ascending trichomes>/  
9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/  
10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/  
11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/  
12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/
13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/  
14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/  
15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/  
16. with glandular trichomes/  
17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/  
18. with barbed trichomes/
- #279. indumentum <of achenes of ray florets; location; descriptors for location of hairs that serve to characterize the taxon>/
- #280. ribs <of achenes of ray florets; presence>/  
1. present/  
2. absent/
- #281. ribs <of achenes of ray florets; number>/  
1. 1/  
2. 2/  
3. 3/  
4. 4/  
5. 5/  
6. 6/  
7. 7/  
8. 8/  
9. 9/  
10. 10/  
11. 12 or more/
- #282. ribs <of achenes of ray florets; distinctive, general characters that serve to distinguish the taxon>/
- #283. ribs <of achenes of ray florets; conspicuousness>/  
1. conspicuous/  
2. inconspicuous/
- #284. wings <of achenes of ray florets; presence>/  
1. present/  
2. absent/
- #285. wings <of achenes of ray florets; distinctive, general characters that serve to distinguish the taxon>/
- #286. wings <of achenes of ray florets; position>/  
1. continuous from apices to bases/  
2. primarily apical/  
3. primarily basal/
- #287. beaks <of achenes of ray florets; presence>/  
1. present/  
2. absent/
- #288. beaks <of achenes of ray florets; distinctive, general characters that serve to distinguish the taxon>/
- #289. beaks <of achenes of ray florets; curvature>/  
1. curved/  
2. not curved/
- #290. beaks <of achenes of ray florets; specific color or colors that serves to distinguish the taxon>/
- #291. beaks <of achenes of ray florets; length>/  
mm long/
- #292. bases <of achenes of ray florets; attachment>/  
1. attached to subtending receptacular bracts/  
2. not attached to subtending receptacular bracts/
- #293. disk florets <presence>/  
1. present/  
2. absent/
- #294. disk florets <number>/  
1. 2/  
2. 3/  
3. 4/

4. 5/
  5. 6/
  6. 7/
  7. 8/
  8. 9/
  9. 10-20/
  10. 20 or more/
- #295. disk florets <distinctive, general characters that serve to distinguish the taxon>/
- #296. disk florets <sexuality> <MANDATORY>/
1. perfect/
  2. pistillate/
  3. staminate/
  4. neuter/
  5. perfect, but functionally pistillate/
  6. perfect, but functionally staminate/
- #297. disk florets <fertility; producing achenes>/
1. fertile/
  2. sterile/
- #298. pappus <of disk florets; presence>/
1. absent/
  2. present; in 1 whorl/
  3. present; in 2 whorls <double>/
- #299. pappus <of disk florets when in 1 whorl; morphological forms>/
1. of awns/
  2. of scales/
  3. of teeth/
  4. of appressed teeth/
  5. of capillary hairs/
  6. of capillary bristles/
  7. of bristles/
  8. of scabrous bristles/
  9. of stiff bristles/
  10. of plumose bristles/
  11. coroniform/
  12. of barbellate bristles/
  13. of scarios scales/
  14. of smooth bristles/
  15. of hairs/
  16. an adaxial auricle <e.g., Anthemis>/
  17. of bristlelike scales/
  18. of stiff scales/
  19. of subclavate hairs/
  20. of subulate hairs <awl-shaped>/
  21. a crenulate rim <e.g., Heliopsis>/
  22. of barbellate awns/
  23. of retrorsely hispid awns/
  24. of fimbriate awns/
  25. of elongate awns/
  26. of serrulate awns/
- #300. pappus <of disk florets; number of parts>/
1. 1/
  2. 2/
  3. 3/
  4. 4/
  5. 5/
  6. 6/
  7. 7/
  8. 8/
  9. 9/
  10. 10/
  11. 11/
  12. 12 or more/
  13. numerous <number, if countable>/
- #301. pappus <of disk florets when in 1 whorl; distinctive, general characters that serve to distinguish the taxon>/
- #302. pappus <of disk florets when in 1 whorl; persistence>/
1. caducous/
  2. persistent in fruit/
  3. not persistent in fruit/
- #303. pappus <of disk florets when in 1 whorl; fusion>/
1. free/
  2. fused/
  3. fused at bases/
- #304. pappus <of disk florets when in 1 whorl; aspect>/
1. appressed/
  2. ascending/
  3. spreading/
  4. reflexed/
  5. curled/
- #305. pappus <of disk florets when in 1 whorl; specific color or colors that serves to distinguish the taxon>/
- #306. pappus <of disk florets when in 1 whorl; nature>/
1. fragile/
  2. stout/
- #307. pappus <of disk florets when in 1 whorl; nature>/
1. slender/
  2. thick/
  3. flattened on outer sides <e.g., Brickellia>/
- #308. pappus <of disk florets when in 1 whorl; width>/
- mm wide/
- #309. pappus <of disk florets when in 1 whorl; equality in length>/
1. all equal in length/
  2. unequal in length/
- #310. pappus <of disk florets when in 1 whorl; length>/
- mm long/
- #311. indumentum <of pappus of disk florets when in 1 whorl>/
1. glabrous/
  2. scabrous <rough to the touch with short, hard, rigid trichomes>/
  3. scaberulous <minutely scabrous>/
  4. pubescent <soft, short, dense trichomes>/
  5. puberulent <minutely pubescent>/
  6. velutinous <soft, short, dense, straight trichomes; velvety>/
  7. tomentose <soft, short, dense, matted trichomes>/
  8. villous <soft, long, dense, curly, ascending trichomes>/
  9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/
  10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/
  11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/
  12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/
  13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/
  14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/
  15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/
  16. with glandular trichomes/
  17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/
  18. with barbed trichomes/
- #312. apices <of pappus of disk florets when in 1 whorl; shape>/
1. rounded/
  2. obtuse/
  3. acute/
  4. acuminate/
- #313. apices <of pappus of disk florets when in 1 whorl>/
1. with midribs excurrent as awns/
  2. with midribs not excurrent as awns/
- #314. margins <of pappus of disk florets when in 1 whorl>/
1. entire/
  2. undulate/
  3. sinuate/



4. crenate/
  5. crenulate/
  6. erose/
  7. serrate/
  8. doubly serrate/
  9. serrulate/
  10. dentate/
  11. denticulate/
  12. incised/
  13. lacerate/
  14. laciniate/
  15. crispate/
  16. ciliate/
  17. spinose/
  18. scarious/
  19. membranous/
- #315. bases <of pappus of disk florets when in 1 whorl; nature>/
1. wide/
  2. narrow/
- #316. bases <of pappus of disk florets when in 1 whorl; nature>/
1. thick/
  2. thin/
- #317. bases <of pappus of disk florets when in 1 whorl; nature>/
1. straight/
  2. curved/
- #318. outer pappus <of disk florets when in 2 whorls; morphological forms>/
1. of awns/
  2. of scales/
  3. of teeth/
  4. of appressed teeth/
  5. of capillary hairs/
  6. of capillary bristles/
  7. of bristles/
  8. of scabrous bristles/
  9. of stiff bristles/
  10. of plumose bristles/
  11. coroniform/
  12. of barbellate bristles/
  13. of scarious scales/
  14. of smooth bristles/
  15. of hairs/
  16. an adaxial auricle < e.g., Anthemis>/
  17. of bristlelike scales/
  18. of stiff scales/
  19. of subclavate hairs/
  20. of subulate hairs <awl-shaped>/
  21. a crenulate rim <e.g., Heliopsis>/
  22. of barbellate awns/
  23. of retrorsely hispid awns/
  24. of fimbriate awns/
  25. of elongate awns/
  26. of serrulate awns/
- #319. outer pappus <of disk florets when in 2 whorls; number of parts>/
1. 1/
  2. 2/
  3. 3/
  4. 4/
  5. 5/
  6. 6/
  7. 7/
  8. 8/
  9. 9/
  10. 10/
  11. 11/
  12. 12 or more/
  13. numerous <number, if countable>/
- #320. outer pappus <of disk florets when in 2 whorls; distinctive, general characters that serve to distinguish the taxon>/
- #321. outer pappus <of disk florets when in 2 whorls; persistence>/
1. caducous/
  2. persistent in fruit/
  3. not persistent in fruit/
- #322. outer pappus <of disk florets when in 2 whorls; fusion>/
1. free/
  2. fused/
  3. fused at bases/
- #323. outer pappus <of disk florets when in 2 whorls; aspect>/
1. appressed/
  2. ascending/
  3. spreading/
  4. reflexed/
  5. curled/
- #324. outer pappus <of disk florets when in 2 whorls; specific color or colors that serves to distinguish the taxon>/
- #325. outer pappus <of disk florets when in 2 whorls; nature>/
1. fragile/
  2. stout/
- #326. outer pappus <of disk florets when in 2 whorls; nature>/
1. slender/
  2. thick/
  3. flattened on outer sides <e.g., Brickellia>/
- #327. outer pappus <of disk florets when in 2 whorls; width>/
- mm wide/
- #328. outer pappus <of disk florets when in 2 whorls; equality in length>/
1. all equal in length/
  2. unequal in length/
- #329. outer pappus <of disk florets when in 2 whorls; length>/
- mm long/
- #330. indumentum <of outer pappus of disk florets when in 2 whorls>/
1. glabrous/
  2. scabrous <rough to the touch with short, hard, rigid trichomes>/
  3. scaberulous <minutely scabrous>/
  4. pubescent <soft, short, dense trichomes>/
  5. puberulent <minutely pubescent>/
  6. velutinous <soft, short, dense, straight trichomes; velvety>/
  7. tomentose <soft, short, dense, matted trichomes>/
  8. villous <soft, long, dense, curly, ascending trichomes>/
  9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/
  10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/
  11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/
  12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/
  13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/
  14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/
  15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/
  16. with glandular trichomes/
  17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/
  18. with barbed trichomes/
- #331. apices <of outer pappus of disk florets when in 2 whorls; shape>/
1. rounded/
  2. obtuse/
  3. acute/
  4. acuminate/
- #332. apices <of outer pappus of disk florets when in 2 whorls>/

1. with midribs excurrent as awns/
  2. midribs not excurrent as awns/
- #333. margins <of outer pappus of disk florets when in 2 whorls>/
1. entire/
  2. undulate/
  3. sinuate/
  4. crenate/
  5. crenulate/
  6. erose/
  7. serrate/
  8. doubly serrate/
  9. serrulate/
  10. dentate/
  11. denticulate/
  12. incised/
  13. lacerate/
  14. lacinate/
  15. crispate/
  16. ciliate/
  17. spinose/
  18. scarious/
  19. membranous/
- #334. bases <of outer pappus of disk florets when in 2 whorls; nature>/
1. wide/
  2. narrow/
- #335. bases <of outer pappus of disk florets when in 2 whorls; nature>/
1. thick/
  2. thin/
- #336. bases <of outer pappus of disk florets when in 2 whorls; nature>/
1. straight/
  2. curved/
- #337. inner pappus <of disk florets when in 2 whorls; morphological forms>/
1. of awns/
  2. of scales/
  3. of teeth/
  4. of appressed teeth/
  5. of capillary hairs/
  6. of capillary bristles/
  7. of bristles/
  8. of scabrous bristles/
  9. of stiff bristles/
  10. of plumose bristles/
  11. coroniform/
  12. of barbellate bristles/
  13. of scarious scales/
  14. of smooth bristles/
  15. of hairs/
  16. an adaxial auricle < e.g., Anthemis>/
  17. of bristlelike scales/
  18. of stiff scales/
  19. of subclavate hairs/
  20. of subulate hairs <awl-shaped>/
  21. a crenulate rim <e.g., Heliopsis>/
  22. of barbellate awns/
  23. of retrorsely hispid awns/
  24. of fimbriate awns/
  25. of elongate awns/
  26. of serrulate awns/
- #338. inner pappus <of disk florets when in 2 whorls; number of parts>/
1. 1/
  2. 2/
  3. 3/
  4. 4/
  5. 5/
  6. 6/
  7. 7/
  8. 8/
  9. 9/
  10. 10/
11. 11/
  12. 12 or more/
  13. numerous <number, if countable>/
- #339. inner pappus <of disk florets when in 2 whorls; distinctive, general characters that serve to distinguish the taxon>/
- #340. inner pappus <of disk florets when in 2 whorls; persistence>/
1. caducous/
  2. persistent in fruit/
  3. not persistent in fruit/
- #341. inner pappus <of disk florets when in 2 whorls; fusion>/
1. free/
  2. fused/
  3. fused at bases/
- #342. inner pappus <of disk florets when in 2 whorls; aspect>/
1. appressed/
  2. ascending/
  3. spreading/
  4. reflexed/
  5. curled/
- #343. inner pappus <of disk florets when in 2 whorls; specific color or colors that serves to distinguish the taxon>/
- #344. inner pappus <of disk florets when in 2 whorls; nature>/
1. fragile/
  2. stout/
- #345. inner pappus <of disk florets when in 2 whorls; nature>/
1. slender/
  2. thick/
  3. flattened on outer sides <e.g., Brickellia>/
- #346. inner pappus <of disk florets when in 2 whorls; width>/
- mm wide/
- #347. inner pappus <of disk florets when in 2 whorls; equality in length>/
1. all equal in length/
  2. unequal in length/
- #348. inner pappus <of disk florets when in 2 whorls; length>/
- mm long/
- #349. indumentum <of inner pappus of disk florets when in 2 whorls>/
1. glabrous/
  2. scabrous <rough to the touch with short, hard, rigid trichomes>/
  3. scaberulous <minutely scabrous>/
  4. pubescent <soft, short, dense trichomes>/
  5. puberulent <minutely pubescent>/
  6. velutinous <soft, short, dense, straight trichomes; velvety>/
  7. tomentose <soft, short, dense, matted trichomes>/
  8. villous <soft, long, dense, curly, ascending trichomes>/
  9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/
  10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/
  11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/
  12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/
  13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/
  14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/
  15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/
  16. with glandular trichomes/
  17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/
  18. with barbed trichomes/

- #350. apices <of inner pappus of disk florets when in 2 whorls; shape>/  
 1. rounded/  
 2. obtuse/  
 3. acute/  
 4. acuminate/
- #351. apices <of inner pappus of disk florets when in 2 whorls>/  
 1. with midribs excurrent as awns/  
 2. with midribs not excurrent as awns/
- #352. margins <of inner pappus of disk florets when in 2 whorls>/  
 1. entire/  
 2. undulate/  
 3. sinuate/  
 4. crenate/  
 5. crenulate/  
 6. erose/  
 7. serrate/  
 8. doubly serrate/  
 9. serrulate/  
 10. dentate/  
 11. denticulate/  
 12. incised/  
 13. lacerate/  
 14. lacinate/  
 15. crispate/  
 16. ciliate/  
 17. spinose/  
 18. scarious/  
 19. membranous/
- #353. bases <of inner pappus of disk florets when in 2 whorls; nature>/  
 1. wide/  
 2. narrow/
- #354. bases <of inner pappus of disk florets when in 2 whorls; nature>/  
 1. thick/  
 2. thin/
- #355. bases <of inner pappus of disk florets when in 2 whorls; nature>/  
 1. straight/  
 2. curved/
- #356. corollas <of disk florets; distinctive, general characters that serve to distinguish the taxon>/
- #357. corollas <of disk florets; fusion of lobes>/  
 1. 4-lobed/  
 2. 5-lobed/  
 3. shallowly 5-lobed/  
 4. deeply 5-lobed/
- #358. corollas <of disk florets; persistence>/  
 1. cauducous/  
 2. persistent at maturity/  
 3. deciduous at maturity/
- #359. corollas <of disk florets; specific color or colors that serves to distinguish the taxon>/
- #360. corollas <of disk florets; texture>/  
 1. membranous/  
 2. fleshy/  
 3. succulent/  
 4. cartilaginous <hard and tough, but flexible>/  
 5. chartaceous <papery, opaque and thin, e.g., Hymenoxys>/  
 6. coriaceous <leathery>/  
 7. flaccid <lax and weak>/  
 8. herbaceous <soft and succulent>/  
 9. hyaline <thin and translucent or transparent>/  
 10. indurate <hardened>/  
 11. scarious <thin and dry>/
- #361. corollas <of disk florets; shape>/  
 1. campanulate/  
 2. salverform/  
 3. funnelform/  
 4. tubular/  
 5. urceolate/
- #362. corollas <of disk florets; width>/  
 mm wide/
- #363. corollas <of disk florets; length>/  
 mm long/
- #364. indumentum <of corollas of disk florets>/  
 1. glabrous/  
 2. scabrous <rough to the touch with short, hard, rigid trichomes>/  
 3. scaberulous <minutely scabrous>/  
 4. pubescent <soft, short, dense trichomes>/  
 5. puberulent <minutely pubescent>/  
 6. velutinous <soft, short, dense, straight trichomes; velvety>/  
 7. tomentose <soft, short, dense, matted trichomes>/  
 8. villous <soft, long, dense, curly, ascending trichomes>/  
 9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/  
 10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/  
 11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/  
 12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/  
 13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/  
 14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/  
 15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/  
 16. with glandular trichomes/  
 17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/  
 18. with barbed trichomes/
- #365. indumentation <of corollas of disk florets; description of indumentation and location that serves to distinguish the taxon>/
- #366. lobes <of disk florets; aspect>/  
 1. erect/  
 2. ascending/  
 3. spreading/  
 4. reflexed/  
 5. curled/
- #367. apices <of corolla lobes of disk florets; shape>/  
 1. rounded/  
 2. obtuse/  
 3. acute/  
 4. acuminate/
- #368. bases of corolla tubes <of disk florets; enlargement>/  
 1. not enlarged in fruit <implicit>/  
 2. slightly saccate in fruit <e.g., Achillea>/  
 3. swollen in fruit/
- #369. stamens <of disk florets; presence>/  
 1. present/  
 2. absent/
- #370. stamens <of disk florets; number>/  
 1. 3/  
 2. 4/  
 3. 5/
- #371. stamens <of disk florets; distinctive, general characters that serve to distinguish the taxon>/
- #372. stamens <of disk florets; length>/  
 mm long/

- #373. stamens <of disk florets; fusion>/  
 1. free/  
 2. fused by filaments/  
 3. fused by anthers <implicit>/
- #374. anthers <of disk florets; distinctive, general characteristics that serve to distinguish the taxon> /
- #375. anthers <of disk florets; specific color or colors that serves to distinguish the taxon> /
- #376. anthers <of disk florets; straightness> /  
 1. straight/  
 2. curved/
- #377. anthers <of disk florets; width> /  
 mm wide/
- #378. anthers <of disk florets; length> /  
 mm long/
- #379. apical appendages <of anthers of disk florets; presence> /  
 1. present/  
 2. absent/
- #380. apical appendages <of anthers of disk florets; appearance> /  
 1. flat/  
 2. keeled/  
 3. curved/
- #381. apical appendages <of anthers of disk florets; shape> /  
 1. linear/  
 2. lanceolate/  
 3. subulate/  
 4. spatulate/
- #382. apical appendages <of anthers of disk florets; width> /  
 mm wide/
- #383. apical appendages <of anthers of disk florets; length> /  
 mm long/
- #384. thecae <of anthers of disk florets; distinctive, general characteristics that serve to distinguish the taxon> /
- #385. bases <of anthers of disk florets; shape> /  
 1. obtuse/  
 2. subtruncate/  
 3. rounded/  
 4. sagittate/  
 5. caudate <tailed> /
- #386. connective tissue <of anthers of disk florets; distinctive, general characters that serve to distinguish the taxon> /
- #387. pollen <of disk florets; distinctive, general characters that serve to distinguish the taxon> /
- #388. filaments <of disk florets; distinctive, general characters that serve to distinguish the taxon> /
- #389. styles <of disk florets; presence> /  
 1. present <implicit> /  
 2. absent/
- #390. styles <of disk florets; distinctive, general characters that serve to distinguish the taxon> /
- #391. styles <of disk florets; division> /  
 1. divided/  
 2. not divided/
- #392. styles <of disk florets; describe degree of division if serves to distinguish the taxon> /
- #393. styles <of disk florets; length> /  
 mm long/
- #394. styles <of disk florets; length relative to corolla tubes> /  
 1. exerted beyond corolla tubes/  
 2. included within corolla tubes/  
 3. equalling corolla tubes/
- #395. style branches <of disk florets; presence> /  
 1. present/  
 2. absent/
- #396. style branches <of disk florets; distinctive, general characters that serve to distinguish the taxon> /
- #397. style branches <of disk florets; lobing> /  
 1. not lobed/  
 2. 2-lobed/
- #398. style branches <of disk florets; color or colors that serves to distinguish the taxon> /
- #399. style branches <of disk florets; shape> /  
 1. linear/  
 2. clavate/  
 3. filiform/  
 4. lanceolate/
- #400. style branches <of disk florets; organization of stigmatic regions> /  
 1. stigmatic regions on adaxial surfaces/  
 2. stigmatic regions forming 2 marginal bands/
- #401. indumentum <of style branches of disk florets> /  
 1. glabrous/  
 2. scabrous <rough to the touch with short, hard, rigid trichomes> /  
 3. scaberulous <minutely scabrous> /  
 4. pubescent <soft, short, dense trichomes> /  
 5. puberulent <minutely pubescent> /  
 6. velutinous <soft, short, dense, straight trichomes; velvety> /  
 7. tomentose <soft, short, dense, matted trichomes> /  
 8. villous <soft, long, dense, curly, ascending trichomes> /  
 9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky> /  
 10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly> /  
 11. pilose <soft, long, sparse, ascending, curly or straight trichomes> /  
 12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby> /  
 13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes> /  
 14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly> /  
 15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes> /  
 16. with glandular trichomes/  
 17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters> /  
 18. with barbed trichomes/
- #402. sterile appendages <of style branches of disk florets; presence> /  
 1. present/  
 2. absent/
- #403. apices <of style branches of disk florets; shape> /  
 1. attenuate/  
 2. broadly rounded/  
 3. truncate/  
 4. obtuse/  
 5. acute/  
 6. acuminate/  
 7. triangular/
- #404. bases <of styles of disk florets; nature> /  
 1. swollen/  
 2. not swollen/  
 3. not swollen but with shaft enlarged/
- #405. bases <of styles of disk florets; nectaries> /  
 1. nectaries present/  
 2. nectaries absent/

- #406. indumentum <of bases of styles of disk florets>/
1. glabrous/
  2. scabrous <rough to the touch with short, hard, rigid trichomes>/
  3. scaberulous <minutely scabrous>/
  4. pubescent <soft, short, dense trichomes>/
  5. puberulent <minutely pubescent>/
  6. velutinous <soft, short, dense, straight trichomes; velvety>/
  7. tomentose <soft, short, dense, matted trichomes>/
  8. villous <soft, long, dense, curly, ascending trichomes>/
  9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/
  10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/
  11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/
  12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/
  13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/
  14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/
  15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/
  16. with glandular trichomes/
  17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/
  18. with barbed trichomes/
- #407. sweeping hairs <on styles and style branches of disk florets; presence>/
1. present/
  2. absent/
- #408. sweeping hairs <on styles and style branches of disk florets; arrangement>/
1. scattered abaxially along style branches and extending down shafts of styles <e.g., Vernonia>/
  2. in ring on shafts below style branches <e.g., Cardus>/
  3. concentrated on tips of style branches/
  4. forming terminal truncate brushes on style branches <e.g., Senecio>/
- #409. sweeping hairs <on styles and style branches of disk florets; distinctive, general characters that serve to distinguish the taxon>/
- #410. achenes <of disk florets; presence>/
1. present/
  2. absent/
- #411. achenes <of disk florets; distinctiveness>/
1. vestigial/
  2. developed/
- #412. achenes <of disk florets; distinctive, general characters that serve to distinguish the taxon>/
- #413. achenes <of disk florets; color or colors that serves to distinguish the taxon>/
- #414. achenes <of disk florets; surface>/
1. smooth/
  2. glandular/
  3. spiny/
  4. rugulose/
  5. setose <covered with bristles>/
  6. muricate/
  7. tuberculate/
  8. undulating/
  9. rugose/
  10. sulcate/
  11. striate/
- #415. achenes <of disk florets; shape in cross-section >/
1. angular/
  2. terete/
  3. trigonous/
  4. tetragonous/
  5. pentagonous/
6. flattened/
7. lenticular/
- #416. achenes <of disk florets; shape in longitudinal-section>/
1. columnar/
  2. conical/
  3. fusiform/
  4. ovate/
  5. oblong/
  6. obconical/
  7. elliptic/
  8. obovate/
  9. oblanceolate/
  10. lanceolate/
  11. linear/
  12. clavate/
  13. cylindrical/
- #417. achenes <of disk florets; width>/
- mm wide/
- #418. achenes <of disk florets; length>/
- mm long/
- #419. indumentum <of achenes of disk florets>/
1. glabrous/
  2. scabrous <rough to the touch with short, hard, rigid trichomes>/
  3. scaberulous <minutely scabrous>/
  4. pubescent <soft, short, dense trichomes>/
  5. puberulent <minutely pubescent>/
  6. velutinous <soft, short, dense, straight trichomes; velvety>/
  7. tomentose <soft, short, dense, matted trichomes>/
  8. villous <soft, long, dense, curly, ascending trichomes>/
  9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/
  10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/
  11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/
  12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/
  13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/
  14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/
  15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/
  16. with glandular trichomes/
  17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/
  18. with barbed trichomes/
- #420. indumentum <of achenes of disk florets; location; descriptors for location of hairs that serve to characterize the taxon>/
- #421. ribs <of achenes of disk florets; presence>/
1. present/
  2. absent/
- #422. ribs <of achenes of disk florets; number>/
1. 1/
  2. 2/
  3. 3/
  4. 4/
  5. 5/
  6. 6/
  7. 7/
  8. 8/
  9. 9/
  10. 10/
  11. 12 or more/
- #423. ribs <of achenes of disk florets; distinctive, general characters that serve to distinguish the taxon>/
- #424. ribs <of achenes of disk florets; conspicuousness>/
1. conspicuous/

2. inconspicuous/
- #425. wings <of achenes of disk florets; presence>/  
1. present/  
2. absent/
- #426. wings <of achenes of disk florets; distinctive, general characters that serve to distinguish the taxon>/
- #427. wings <of achenes of disk florets; position>/  
1. continuous from apices to bases/  
2. primarily apical/  
3. primarily basal/
- #428. beaks <of achenes of disk florets; presence>/  
1. present/  
2. absent/
- #429. beaks <of achenes of disk florets; distinctive, general characters that serve to distinguish the taxon>/
- #430. beaks <of achenes of disk florets; curvature>/  
1. curved/  
2. not curved/
- #431. beaks <of achenes of disk florets; specific color or colors that serves to distinguish the taxon>/
- #432. beaks <of achenes of disk florets; length>/  
mm long/
- #433. bases <of achenes of disk florets; attachment>/  
1. attached to subtending receptacular bracts/  
2. not attached to subtending receptacular bracts/
- #434. ligulate florets <presence>/  
1. present/  
2. absent/
- #435. ligulate florets <number>/  
1. 2/  
2. 3/  
3. 4/  
4. 5/  
5. 6/  
6. 7/  
7. 8/  
8. 9/  
9. 10-20/  
10. 20 or more/
- #436. ligulate florets <distinctive, general characters that serve to distinguish the taxon>/
- #437. ligulate florets <sexuality> <MANDATORY>/  
1. perfect/  
2. pistillate/  
3. staminate/  
4. neuter/  
5. perfect, but functionally pistillate/  
6. perfect, but functionally staminate/
- #438. ligulate florets <fertility; producing achenes>/  
1. fertile/  
2. sterile/
- #439. pappus <of ligulate florets; presence>/  
1. absent/  
2. present; in 1 whorl/  
3. present; in 2 whorls <double>/
- #440. pappus <of ligulate florets when in 1 whorl; morphological forms>/  
1. of awns/  
2. of scales/  
3. of teeth/  
4. of appressed teeth/  
5. of capillary hairs/  
6. of capillary bristles/  
7. of bristles/  
8. of scabrous bristles/  
9. of stiff bristles/  
10. of plumose bristles/  
11. coroniform/  
12. of barbellate bristles/  
13. of scarious scales/  
14. of smooth bristles/  
15. of hairs/  
16. an adaxial auricle <e.g., Anthemis>/  
17. of bristlelike scales/  
18. of stiff scales/  
19. of subclavate hairs/  
20. of subulate hairs <awl-shaped>/  
21. a crenulate rim <e.g., Heliopsis>/  
22. of barbellate awns/  
23. of retrorsely hispid awns/  
24. of fimbriate awns/  
25. of elongate awns/  
26. of serrulate awns/
- #441. pappus <of ligulate florets; number of parts>/  
1. 1/  
2. 2/  
3. 3/  
4. 4/  
5. 5/  
6. 6/  
7. 7/  
8. 8/  
9. 9/  
10. 10/  
11. 11/  
12. 12 or more/  
13. numerous <number, if countable>/
- #442. pappus <of ligulate florets when in 1 whorl; distinctive, general characters that serve to distinguish the taxon>/
- #443. pappus <of ligulate florets when in 1 whorl; persistence>/  
1. caducous/  
2. persistent in fruit/  
3. not persistent in fruit/
- #444. pappus <of ligulate florets when in 1 whorl; fusion>/  
1. free/  
2. fused/  
3. fused at bases/
- #445. pappus <of ligulate florets when in 1 whorl; aspect>/  
1. appressed/  
2. ascending/  
3. spreading/  
4. reflexed/  
5. curled/
- #446. pappus <of ligulate florets when in 1 whorl; specific color or colors that serves to distinguish the taxon>/
- #447. pappus <of ligulate florets when in 1 whorl; nature>/  
1. fragile/  
2. stout/
- #448. pappus <of ligulate florets when in 1 whorl; nature>/  
1. slender/  
2. thick/  
3. flattened on outer sides <e.g., Brickellia>/
- #449. pappus <of ligulate florets when in 1 whorl; width>/  
mm wide/
- #450. pappus <of ligulate florets when in 1 whorl; equality in length>/  
1. all equal in length/  
2. unequal in length/
- #451. pappus <of ligulate florets when in 1 whorl; length>/  
mm long/
- #452. indumentum <of pappus of ligulate florets when in 1 whorl>/  
1. glabrous/

2. scabrous <rough to the touch with short, hard, rigid trichomes>/
  3. scaberulous <minutely scabrous>/
  4. pubescent <soft, short, dense trichomes>/
  5. puberulent <minutely pubescent>/
  6. velutinous <soft, short, dense, straight trichomes; velvety>/
  7. tomentose <soft, short, dense, matted trichomes>/
  8. villous <soft, long, dense, curly, ascending trichomes>/
  9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/
  10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/
  11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/
  12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/
  13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/
  14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/
  15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/
  16. with glandular trichomes/
  17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/
  18. with barbed trichomes/
- #453. apices <of pappus of ligulate florets when in 1 whorl; shape>/
1. rounded/
  2. obtuse/
  3. acute/
  4. acuminate/
- #454. apices <of pappus of ligulate florets when in 1 whorl>/
1. with midribs excurrent as awns/
  2. with midribs not excurrent as awns/
- #455. margins <of pappus of ligulate florets when in 1 whorl>/
1. entire/
  2. undulate/
  3. sinuate/
  4. crenate/
  5. crenulate/
  6. erose/
  7. serrate/
  8. doubly serrate/
  9. serrulate/
  10. dentate/
  11. denticulate/
  12. incised/
  13. lacerate/
  14. lacinate/
  15. crispate/
  16. ciliate/
  17. spinose/
  18. scarious/
  19. membranous/
- #456. bases <of pappus of ligulate florets when in 1 whorl; nature>/
1. wide/
  2. narrow/
- #457. bases <of pappus of ligulate florets when in 1 whorl; nature>/
1. thick/
  2. thin/
- #458. bases <of pappus of ligulate florets when in 1 whorl; nature>/
1. straight/
  2. curved/
- #459. outer pappus <of ligulate florets when in 2 whorls; morphological forms>/
1. of awns/
  2. of scales/
  3. of teeth/
  4. of appressed teeth/
  5. of capillary hairs/
  6. of capillary bristles/
  7. of bristles/
  8. of scabrous bristles/
  9. of stiff bristles/
  10. of plumose bristles/
  11. coroniform/
  12. of barbellate bristles/
  13. of scarious scales/
  14. of smooth bristles/
  15. of hairs/
  16. an adaxial auricle <e.g., Anthemis>/
  17. of bristlelike scales/
  18. of stiff scales/
  19. of subclavate hairs/
  20. of subulate hairs <awl-shaped>/
  21. a crenulate rim <e.g., Heliopsis>/
  22. of barbellate awns/
  23. of retrorsely hispid awns/
  24. of fimbriate awns/
  25. of elongate awns/
  26. of serrulate awns/
- #460. outer pappus <of ligulate florets when in 2 whorls; number of parts>/
1. 1/
  2. 2/
  3. 3/
  4. 4/
  5. 5/
  6. 6/
  7. 7/
  8. 8/
  9. 9/
  10. 10/
  11. 11/
  12. 12 or more/
  13. numerous <number, if countable>/
- #461. outer pappus <of ligulate florets when in 2 whorls; distinctive, general characters that serve to distinguish the taxon>/
- #462. outer pappus <of ligulate florets when in 2 whorls; persistence>/
1. caducous/
  2. persistent in fruit/
  3. not persistent in fruit/
- #463. outer pappus <of ligulate florets when in 2 whorls; fusion>/
1. free/
  2. fused/
  3. fused at bases/
- #464. outer pappus <of ligulate florets when in 2 whorls; aspect>/
1. appressed/
  2. ascending/
  3. spreading/
  4. reflexed/
  5. curled/
- #465. outer pappus <of ligulate florets when in 2 whorls; specific color or colors that serves to distinguish the taxon>/
- #466. outer pappus <of ligulate florets when in 2 whorls; nature>/
1. fragile/
  2. stout/
- #467. outer pappus <of ligulate florets when in 2 whorls; nature>/
1. slender/
  2. thick/
  3. flattened on outer sides <e.g., Brickellia>/
- #468. outer pappus <of ligulate florets when in 2 whorls; width>/

- mm wide/
- #469. outer pappus <of ligulate florets when in 2 whorls; equality in length>/  
1. all equal in length/  
2. unequal in length/
- #470. outer pappus <of ligulate florets when in 2 whorls; length>/  
mm long/
- #471. indumentum <of outer pappus of ligulate florets when in 2 whorls>/  
1. glabrous/  
2. scabrous <rough to the touch with short, hard, rigid trichomes>/  
3. scaberulous <minutely scabrous>/  
4. pubescent <soft, short, dense trichomes>/  
5. puberulent <minutely pubescent>/  
6. velutinous <soft, short, dense, straight trichomes; velvety>/  
7. tomentose <soft, short, dense, matted trichomes>/  
8. villous <soft, long, dense, curly, ascending trichomes>/  
9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/  
10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/  
11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/  
12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/  
13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/  
14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/  
15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/  
16. with glandular trichomes/  
17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/  
18. with barbed trichomes/
- #472. apices <of outer pappus of ligulate florets when in 2 whorls; shape>/  
1. rounded/  
2. obtuse/  
3. acute/  
4. acuminate/
- #473. apices <of outer pappus of ligulate florets when in 2 whorls>/  
1. with midribs excurrent as awns/  
2. midribs not excurrent as awns/
- #474. margins <of outer pappus of ligulate florets when in 2 whorls>/  
1. entire/  
2. undulate/  
3. sinuate/  
4. crenate/  
5. crenulate/  
6. erose/  
7. serrate/  
8. doubly serrate/  
9. serrulate/  
10. dentate/  
11. denticulate/  
12. incised/  
13. lacerate/  
14. laciniate/  
15. crispate/  
16. ciliate/  
17. spinose/  
18. scarious/  
19. membranous/
- #475. bases <of outer pappus of ligulate florets when in 2 whorls; nature>/  
1. wide/  
2. narrow/
- #476. bases <of outer pappus of ligulate florets when in 2 whorls; nature>/  
1. thick/  
2. thin/
- #477. bases <of outer pappus of ligulate florets when in 2 whorls; nature>/  
1. straight/  
2. curved/
- #478. inner pappus <of ligulate florets when in 2 whorls; morphological forms>/  
1. of awns/  
2. of scales/  
3. of teeth/  
4. of appressed teeth/  
5. of capillary hairs/  
6. of capillary bristles/  
7. of bristles/  
8. of scabrous bristles/  
9. of stiff bristles/  
10. of plumose bristles/  
11. coroniform/  
12. of barbellate bristles/  
13. of scarious scales/  
14. of smooth bristles/  
15. of hairs/  
16. an adaxial auricle <e.g., Anthemis>/  
17. of bristlelike scales/  
18. of stiff scales/  
19. of subclavate hairs/  
20. of subulate hairs <awl-shaped>/  
21. a crenulate rim <e.g., Heliopsis>/  
22. of barbellate awns/  
23. of retrorsely hispid awns/  
24. of fimbriate awns/  
25. of elongate awns/  
26. of serrulate awns/
- #479. inner pappus <of ligulate florets when in 2 whorls; number of parts>/  
1. 1/  
2. 2/  
3. 3/  
4. 4/  
5. 5/  
6. 6/  
7. 7/  
8. 8/  
9. 9/  
10. 10/  
11. 11/  
12. 12 or more/  
13. numerous <number, if countable>/
- #480. inner pappus <of ligulate florets when in 2 whorls; distinctive, general characters that serve to distinguish the taxon>/
- #481. inner pappus <of ligulate florets when in 2 whorls; persistence>/  
1. caducous/  
2. persistent in fruit/  
3. not persistent in fruit/
- #482. inner pappus <of ligulate florets when in 2 whorls; fusion>/  
1. free/  
2. fused/  
3. fused at bases/
- #483. inner pappus <of ligulate florets when in 2 whorls; aspect>/  
1. apressed/  
2. ascending/  
3. spreading/  
4. reflexed/  
5. curled/
- #484. inner pappus <of ligulate florets when in 2 whorls; specific color or colors that serves to distinguish the



- taxon>/
- #485. inner pappus <of ligulate florets when in 2 whorls; nature>/  
 1. fragile/  
 2. stout/
- #486. inner pappus <of ligulate florets when in 2 whorls; nature>/  
 1. slender/  
 2. thick/  
 3. flattened on outer sides <e.g., Brickellia>/
- #487. inner pappus <of ligulate florets when in 2 whorls; width>/  
 mm wide/
- #488. inner pappus <of ligulate florets when in 2 whorls; equality in length>/  
 1. all equal in length/  
 2. unequal in length/
- #489. inner pappus <of ligulate florets when in 2 whorls; length>/  
 mm long/
- #490. indumentum <of inner pappus of ligulate florets when in 2 whorls>/  
 1. glabrous/  
 2. scabrous <rough to the touch with short, hard, rigid trichomes>/  
 3. scaberulous <minutely scabrous>/  
 4. pubescent <soft, short, dense trichomes>/  
 5. puberulent <minutely pubescent>/  
 6. velutinous <soft, short, dense, straight trichomes; velvety>/  
 7. tomentose <soft, short, dense, matted trichomes>/  
 8. villous <soft, long, dense, curly, ascending trichomes>/  
 9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/  
 10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/  
 11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/  
 12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/  
 13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/  
 14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/  
 15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/  
 16. with glandular trichomes/  
 17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/  
 18. with barbed trichomes/
- #491. apices <of inner pappus of ligulate florets when in 2 whorls; shape>/  
 1. rounded/  
 2. obtuse/  
 3. acute/  
 4. acuminate/
- #492. apices <of inner pappus of ligulate florets when in 2 whorls>/  
 1. with midribs excurrent as awns/  
 2. with midribs not excurrent as awns/
- #493. margins <of inner pappus of ligulate florets when in 2 whorls>/  
 1. entire/  
 2. undulate/  
 3. sinuate/  
 4. crenate/  
 5. crenulate/  
 6. erose/  
 7. serrate/  
 8. doubly serrate/  
 9. serrulate/  
 10. dentate/
11. denticulate/  
 12. incised/  
 13. lacerate/  
 14. lacinate/  
 15. crispate/  
 16. ciliate/  
 17. spinose/  
 18. scarious/  
 19. membranous/
- #494. bases <of inner pappus of ligulate florets when in 2 whorls; nature>/  
 1. wide/  
 2. narrow/
- #495. bases <of inner pappus of ligulate florets when in 2 whorls; nature>/  
 1. thick/  
 2. thin/
- #496. bases <of inner pappus of ligulate florets when in 2 whorls; nature>/  
 1. straight/  
 2. curved/
- #497. corollas <of ligulate florets; distinctive, general characters that serve to distinguish the taxon>/
- #498. corollas <of ligulate florets; fusion of lobes>/  
 1. minutely 5-lobed/  
 2. deeply 5-lobed/
- #499. corollas <of ligulate florets; persistence>/  
 1. cauducous/  
 2. persistent at maturity/  
 3. deciduous at maturity/
- #500. corollas <of ligulate florets; aspect>/  
 1. erect/  
 2. ascending/  
 3. spreading/  
 4. reflexed/  
 5. curled/
- #501. corollas <of ligulate florets; specific color or colors that serves to distinguish the taxon>/
- #502. corollas <of ligulate florets; limb texture>/  
 1. membranous/  
 2. fleshy/  
 3. succulent/  
 4. cartilaginous <hard and tough, but flexible>/  
 5. chartaceous <papery, opaque and thin, e.g., Hymenoxys>/  
 6. coriaceous <leathery>/  
 7. flaccid <lax and weak>/  
 8. herbaceous <soft and succulent>/  
 9. hyaline <thin and translucent or transparent>/  
 10. indurate <hardened>/  
 11. scarious <thin and dry>/
- #503. corollas <of ligulate florets; limb shape>/  
 1. spatulate/  
 2. cucullate/  
 3. linear/  
 4. emarginate/  
 5. bifid/  
 6. rhomboid/  
 7. deltoid/  
 8. triangular/  
 9. ovate/  
 10. lanceolate/  
 11. oblanceolate/  
 12. obovate/  
 13. oblong/  
 14. orbicular/
- #504. corollas <of ligulate florets; width>/  
 mm wide/

- #505. corollas <of ligulate florets; length including length of tube>/  
mm long/
- #506. corollas <of ligulate florets; venation>/  
1. 6-veined/  
2. many veined/
- #507. indumentum <of corollas of ligulate florets>/  
1. glabrous/  
2. scabrous <rough to the touch with short, hard, rigid trichomes>/  
3. scaberulous <minutely scabrous>/  
4. pubescent <soft, short, dense trichomes>/  
5. puberulent <minutely pubescent>/  
6. velutinous <soft, short, dense, straight trichomes; velvety>/  
7. tomentose <soft, short, dense, matted trichomes>/  
8. villous <soft, long, dense, curly, ascending trichomes>/  
9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/  
10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/  
11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/  
12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/  
13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/  
14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/  
15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/  
16. with glandular trichomes/  
17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/  
18. with barbed trichomes/
- #508. indumentation <of corollas of ligulate florets; description of indumentation and location that serves to distinguish the taxon>/
- #509. apices <of corolla lobes of ligulate florets; shape>/  
1. rounded/  
2. obtuse/  
3. acute/  
4. acuminate/
- #510. bases of corolla tubes <of ligulate florets; enlargement>/  
1. not enlarged in fruit <implicit>/  
2. slightly saccate in fruit <e.g., Achillea>/  
3. swollen in fruit/
- #511. stamens <of ligulate florets; presence>/  
1. present/  
2. absent/
- #512. stamens <of ligulate florets; number>/  
1. 3/  
2. 4/  
3. 5/
- #513. stamens <of ligulate florets; distinctive, general characters that serve to distinguish the taxon>/
- #514. stamens <of ligulate florets; length>/  
mm long/
- #515. stamens <of ligulate florets; fusion>/  
1. free/  
2. fused by filaments/  
3. fused by anthers <implicit>/
- #516. anthers <of ligulate florets; distinctive, general characteristics that serve to distinguish the taxon>/
- #517. anthers <of ligulate florets; specific color or colors that serves to distinguish the taxon>/
- #518. anthers <of ligulate florets; straightness>/  
1. straight/  
2. curved/
- #519. anthers <of ligulate florets; width>/  
mm wide/
- #520. anthers <of ligulate florets; length>/  
mm long/
- #521. apical appendages <of anthers of ligulate florets; presence>/  
1. present/  
2. absent/
- #522. apical appendages <of anthers of ligulate florets; appearance>/  
1. flat/  
2. keeled/  
3. curved/
- #523. apical appendages <of anthers of ligulate florets; shape>/  
1. linear/  
2. lanceolate/  
3. subulate/  
4. spatulate/
- #524. apical appendages <of anthers of ligulate florets; width>/  
mm wide/
- #525. apical appendages <of anthers of ligulate florets; length>/  
mm long/
- #526. thecae <of anthers of ligulate florets; distinctive, general characteristics that serve to distinguish the taxon>/
- #527. bases <of anthers of ligulate florets; shape>/  
1. obtuse/  
2. subtruncate/  
3. rounded/  
4. sagittate/  
5. caudate <tailed>/
- #528. connective tissue <of anthers of ligulate florets; distinctive, general characters that serve to distinguish the taxon>/
- #529. pollen <of ligulate florets; distinctive, general characters that serve to distinguish the taxon>/
- #530. filaments <of ligulate florets; distinctive, general characters that serve to distinguish the taxon>/
- #531. styles <of ligulate florets; presence>/  
1. present <implicit>/  
2. absent/
- #532. styles <of ligulate florets; distinctive, general characters that serve to distinguish the taxon>/
- #533. styles <of ligulate florets; division>/  
1. divided/  
2. not divided/
- #534. styles <of ligulate florets; describe degree of division if serves to distinguish the taxon>/
- #535. styles <of ligulate florets; length>/  
mm long/
- #536. styles <of ligulate florets; length relative to corolla tubes>/  
1. exerted beyond corolla tubes/  
2. included within corolla tubes/  
3. equalling corolla tubes/
- #537. style branches <of ligulate florets; presence>/  
1. present/  
2. absent/

- #538. style branches <of ligulate florets; distinctive, general characters that serve to distinguish the taxon>/
- #539. style branches <of ligulate florets; lobing>/  
 1. not lobed/  
 2. 2-lobed/
- #540. style branches <of ligulate florets; color or colors that serves to distinguish the taxon>/
- #541. style branches <of ligulate florets; shape>/  
 1. linear/  
 2. clavate/  
 3. filiform/  
 4. lanceolate/
- #542. style branches <of ligulate florets; organization of stigmatic regions>/  
 1. stigmatic regions on adaxial surfaces/  
 2. stigmatic regions forming 2 marginal bands/
- #543. indumentum <of style branches of ligulate florets>/  
 1. glabrous/  
 2. scabrous <rough to the touch with short, hard, rigid trichomes>/  
 3. scaberulous <minutely scabrous>/  
 4. pubescent <soft, short, dense trichomes>/  
 5. puberulent <minutely pubescent>/  
 6. velutinous <soft, short, dense, straight trichomes; velvety>/  
 7. tomentose <soft, short, dense, matted trichomes>/  
 8. villous <soft, long, dense, curly, ascending trichomes>/  
 9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/  
 10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/  
 11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/  
 12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/  
 13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/  
 14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/  
 15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/  
 16. with glandular trichomes/  
 17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/  
 18. with barbed trichomes/
- #544. sterile appendages <of style branches of ligulate florets; presence>/  
 1. present/  
 2. absent/
- #545. apices <of style branches of ligulate florets; shape>/  
 1. attenuate/  
 2. broadly rounded/  
 3. truncate/  
 4. obtuse/  
 5. acute/  
 6. acuminate/  
 7. triangular/
- #546. bases <of styles of ligulate florets; nature>/  
 1. swollen/  
 2. not swollen/  
 3. not swollen but with shaft enlarged/
- #547. bases <of styles of ligulate florets; nectaries>/  
 1. nectaries present/  
 2. nectaries absent/
- #548. indumentum <of bases of styles of ligulate florets>/  
 1. glabrous/  
 2. scabrous <rough to the touch with short, hard, rigid trichomes>/  
 3. scaberulous <minutely scabrous>/  
 4. pubescent <soft, short, dense trichomes>/  
 5. puberulent <minutely pubescent>/
6. velutinous <soft, short, dense, straight trichomes; velvety>/  
 7. tomentose <soft, short, dense, matted trichomes>/  
 8. villous <soft, long, dense, curly, ascending trichomes>/  
 9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/  
 10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/  
 11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/  
 12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/  
 13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/  
 14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/  
 15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/  
 16. with glandular trichomes/  
 17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/  
 18. with barbed trichomes/
- #549. sweeping hairs <on styles and style branches of ligulate florets; presence>/  
 1. present/  
 2. absent/
- #550. sweeping hairs <on styles and style branches of ligulate florets; arrangement>/  
 1. scattered abaxially along style branches and extending down shafts of styles <e.g., Vernonia>/  
 2. in ring on shafts below style branches <e.g., Cardus>/  
 3. concentrated on tips of style branches/  
 4. forming terminal truncate brushes on style branches <e.g., Senecio>/
- #551. sweeping hairs <on styles and style branches of ligulate florets; distinctive, general characters that serve to distinguish the taxon>/
- #552. achenes <of ligulate florets; presence>/  
 1. present/  
 2. absent/
- #553. achenes <of ligulate florets; distinctiveness>/  
 1. vestigial/  
 2. developed/
- #554. achenes <of ligulate florets; distinctive, general characters that serve to distinguish the taxon>/
- #555. achenes <of ligulate florets; color or colors that serves to distinguish the taxon>/
- #556. achenes <of ligulate florets; surface>/  
 1. smooth/  
 2. glandular/  
 3. spiny/  
 4. rugulose/  
 5. setose <covered with bristles>/  
 6. muricate/  
 7. tuberculate/  
 8. undulating/  
 9. rugose/  
 10. sulcate/  
 11. striate/
- #557. achenes <of ligulate florets; shape in cross-section>/  
 1. angular/  
 2. terete/  
 3. trigonous/  
 4. tetragonous/  
 5. pentagonous/  
 6. flattened/  
 7. lenticular/
- #558. achenes <of ligulate florets; shape in longitudinal-section>/  
 1. columnar/  
 2. conical/

3. fusiform/
  4. ovate/
  5. oblong/
  6. obconical/
  7. elliptic/
  8. obovate/
  9. oblanceolate/
  10. lanceolate/
  11. linear/
  12. clavate/
  13. cylindrical/
- #559. achenes <of ligulate florets; width>/  
mm wide/
- #560. achenes <of ligulate florets; length>/  
mm long/
- #561. indumentum <of achenes of ligulate florets>/
1. glabrous/
  2. scabrous <rough to the touch with short, hard, rigid trichomes>/
  3. scaberulous <minutely scabrous>/
  4. pubescent <soft, short, dense trichomes>/
  5. puberulent <minutely pubescent>/
  6. velutinous <soft, short, dense, straight trichomes; velvety>/
  7. tomentose <soft, short, dense, matted trichomes>/
  8. villous <soft, long, dense, curly, ascending trichomes>/
  9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/
  10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/
  11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/
  12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/
  13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/
  14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/
  15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/
  16. with glandular trichomes/
  17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/
  18. with barbed trichomes/
- #562. indumentum <of achenes of ligulate florets; location; descriptors for location of hairs that serve to characterize the taxon>/
- #563. ribs <of achenes of ligulate florets; presence>/
1. present/
  2. absent/
- #564. ribs <of achenes of ligulate florets; number>/
1. 1/
  2. 2/
  3. 3/
  4. 4/
  5. 5/
  6. 6/
  7. 7/
  8. 8/
  9. 9/
  10. 10/
  11. 12 or more/
- #565. ribs <of achenes of ligulate florets; distinctive, general characters that serve to distinguish the taxon>/
- #566. ribs <of achenes of ligulate florets; conspicuousness>/
1. conspicuous/
  2. inconspicuous/
- #567. wings <of achenes of ligulate florets; presence>/
1. present/
  2. absent/
- #568. wings <of achenes of ligulate florets; distinctive, general characters that serve to distinguish the taxon>/
- #569. wings <of achenes of ligulate florets; position>/
1. continuous from apices to bases/
  2. primarily apical/
  3. primarily basal/
- #570. beaks <of achenes of ligulate florets; presence>/
1. present/
  2. absent/
- #571. beaks <of achenes of ligulate florets; distinctive, general characters that serve to distinguish the taxon>/
- #572. beaks <of achenes of ligulate florets; curvature>/
1. curved/
  2. not curved/
- #573. beaks <of achenes of ligulate florets; specific color or colors that serves to distinguish the taxon>/
- #574. beaks <of achenes of ligulate florets; length>/  
mm long/
- #575. bases <of achenes of ligulate florets; attachment>/
1. attached to subtending receptacular bracts/
  2. not attached to subtending receptacular bracts/
- #576. receptacles <distinctive, general characters that serve to distinguish the taxon>/
- #577. receptacles <shape>/
1. flat/
  2. cylindrical/
  3. concave/
  4. convex/
  5. conical/
  6. globose/
  7. elongate/
  8. subulate/
  9. hemispheric/
  10. subglobose/
- #578. receptacles <density>/
1. solid/
  2. spongy/
  3. hollow <e.g., Heliopsis>/
- #579. surfaces <of receptacles; appearance>/
1. smooth/
  2. pitted <or alveolate>/
- #580. surfaces <of receptacles; indumentum>/
1. glabrous/
  2. indumented <describe if distinctive>/
  3. setose <bristly>/
- #581. receptacular bracts <presence>/
1. present/
  2. absent/
- #582. receptacular bracts <persistence>/
1. persistent/
  2. deciduous/
- #583. receptacular bracts <or receptacular bracts; distinctive, general characters that serve to distinguish the taxon>/
- #584. receptacular bracts <color or colors that serves to distinguish the taxon>/
- #585. receptacular bracts <shape>/
1. linear/
  2. lanceolate/
  3. oblanceolate/
  4. elliptic/
  5. ovate/
  6. obovate/
  7. oblong/

- #586. receptacular bracts <appearance>/  
 1. angular/  
 2. rounded/  
 3. flat/
- #587. receptacular bracts <nature>/  
 1. straight/  
 2. curved/
- #588. receptacular bracts <keels>/  
 1. keeled/  
 2. not keeled/
- #589. receptacular bracts <width>/  
 mm wide/
- #590. receptacular bracts <length>/  
 1. longer than disk florets <e.g., Silphium, Echinacea>/  
 2. shorter than disk florets/
- #591. receptacular bracts <length>/  
 mm long/
- #592. indumentum <of receptacular bracts>/  
 1. glabrous/  
 2. scabrous <rough to the touch with short, hard, rigid trichomes>/  
 3. scaberulous <minutely scabrous>/  
 4. pubescent <soft, short, dense trichomes>/  
 5. puberulent <minutely pubescent>/  
 6. velutinous <soft, short, dense, straight trichomes; velvety>/  
 7. tomentose <soft, short, dense, matted trichomes>/  
 8. villous <soft, long, dense, curly, ascending trichomes>/  
 9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/  
 10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/  
 11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/  
 12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/  
 13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/  
 14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/  
 15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/  
 16. with glandular trichomes/  
 17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/  
 18. with barbed trichomes/
- #593. apices <of receptacular bracts; shape>/  
 1. truncate/  
 2. acute/  
 3. acuminate/  
 4. rounded/  
 5. obtuse/
- #594. apices <of receptacular bracts>/  
 1. with midribs excurrent as awns/  
 2. with midribs not excurrent as awns/
- #595. margins <of receptacular bracts>/  
 1. entire/  
 2. undulate/  
 3. sinuate/  
 4. crenate/  
 5. crenulate/  
 6. erose/  
 7. serrate/  
 8. doubly serrate/  
 9. serrulate/  
 10. dentate/  
 11. denticulate/  
 12. incised/  
 13. lacerate/  
 14. lacinate/  
 15. crispate/  
 16. ciliate/
17. spinose/  
 18. scarious/  
 19. membranous/
- #596. bases <of receptacular bracts; nature>/  
 1. wide/  
 2. narrow/
- #597. bases <of receptacular bracts; nature>/  
 1. thick/  
 2. thin/
- #598. bases <of receptacular bracts; nature>/  
 1. straight/  
 2. curved/
- #599. staminate heads <number; if several to numerous, give range of numbers> <MANDATORY>/
- #600. staminate heads <distinctive, general characters that serve to distinguish the taxon>/
- #601. staminate heads <arrangement; add descriptors as necessary> <MANDATORY>/  
 1. solitary/  
 2. in pairs/  
 3. in cymes/  
 4. in scorpioid cymes/  
 5. in spikes/  
 6. in racemes/  
 7. in rounded panicles/  
 8. in pyramidal panicles/  
 9. in corymbs <flat-topped>/  
 10. in glomerules/  
 11. in fascicles/  
 12. in clusters/
- #602. staminate heads <position on plant>/  
 1. terminal/  
 2. axillary/
- #603. staminate heads <aspect relative to peduncle>/  
 1. held erect <e.g., Solidago rigida>/  
 2. held horizontally <e.g., Silphium laciniatum>/  
 3. held obliquely <e.g., Liatris>/  
 4. pendulous <e.g., Ambrosia>/
- #604. staminate heads <secondary involucre>/  
 1. surrounded by secondary involucres <e.g., Elephantopus>/  
 2. not surrounded by secondary involucres <implicit>/
- #605. staminate heads <floret arrangement> <MANDATORY>/  
 1. with ray florets only/  
 2. with disk florets only/  
 3. with both ray and disk florets/  
 4. with ligulate florets only <Lactuceae>/
- #606. staminate heads <width>/  
 mm wide/
- #607. staminate heads <length>/  
 mm long/
- #608. primary peduncles <of staminate heads; axis terminating in a compound inflorescence of heads or when heads solitary; presence>/  
 1. present <implicit>/  
 2. absent/
- #609. primary peduncles <of staminate heads; axis terminating in a compound inflorescence of heads or when heads solitary; distinctive general characters that serve to distinguish the taxon>/
- #610. primary peduncles <of staminate heads; axis terminating in a compound inflorescence of heads or when heads solitary; length>/  
 cm long/

- #611. secondary peduncles <of staminate heads; axis terminating in a single head; presence>/  
1. present/  
2. absent/
- #612. secondary peduncles <of staminate heads; axis terminating in a single head; distinctive general characters that serve to distinguish the taxon>/
- #613. secondary peduncles <of staminate heads; axis terminating in a single head; length>/  
mm long/
- #614. phyllaries <of staminate heads; presence>/  
1. present <implicit>/  
2. absent <e.g., Psilocarphus>/
- #615. phyllaries <of staminate heads; morphological forms>  
<MANDATORY>/  
1. all alike/  
2. of 2 forms/  
3. of 3 forms/  
4. of 4 or more forms/
- #616. phyllaries <when all alike; staminate heads; number>/  
1. 1/  
2. 2/  
3. 3/  
4. 4/  
5. 5/  
6. 6/  
7. 7/  
8. 8/  
9. 9/  
10. 10/  
11. 12 -20/  
12. 20-30/  
13. 30 or more/
- #617. phyllaries <when all alike; staminate heads; rows>/  
1. in 1 row/  
2. in 2 rows/  
3. in 3 rows <e.g., Zinnia>/  
4. in 4 rows <e.g., Rudbeckia>/  
5. in 5 rows/  
6. in 6 rows/  
7. in 7 or more rows <e.g., Aster patens>/
- #618. phyllaries <when all alike in 1 row; staminate heads; descriptive, general characters that serve to distinguish the taxon>/
- #619. phyllaries <when all alike in 1 row; staminate heads; persistence>/  
1. caducous/  
2. deciduous/  
3. persistent <implicit>/
- #620. phyllaries <when all alike in 1 row; staminate heads; imbricate>/  
1. imbricate/  
2. not imbricate/
- #621. phyllaries <when all alike in 1 row; staminate heads; fusion>/  
1. free/  
2. fused/  
3. fused at bases/  
4. fused, forming a bur/  
5. fused, forming a spiny bur/
- #622. phyllaries <when all alike in 1 row; staminate heads; aspect>/  
1. appressed/  
2. ascending/  
3. spreading/  
4. reflexed/  
5. curled/  
6. deflexed/
- #623. phyllaries <when all alike in 1 row; staminate heads; specific color or colors that serves to distinguish the taxon>/
- #624. phyllaries <when all alike in 1 row; staminate heads; texture>/  
1. fleshy/  
2. succulent/  
3. cartilaginous <hard and tough, but flexible>/  
4. chartaceous <papery, opaque and thin>/  
5. coriaceous <leathery>/  
6. fibrous <having loose, woody strands>/  
7. flaccid <lax and weak>/  
8. herbaceous <soft and succulent>/  
9. hyaline <thin and translucent or transparent>/  
10. indurate <hardened>/  
11. membranous <thin and semi-transparent>/  
12. scarious <thin and dry>/  
13. spongy <cellular, sponge-like>/  
14. subherbaceous/  
15. foliaceous <leaf-like>/
- #625. phyllaries <when all alike in 1 row; staminate heads; shape>/  
1. subulate/  
2. acicular/  
3. filiform/  
4. linear/  
5. lanceolate/  
6. oblanceolate/  
7. ovate/  
8. obovate/  
9. elliptic/  
10. oblong/  
11. spatulate/  
12. runcinate/  
13. pandurate/  
14. deltoid/  
15. obdeltoid/  
16. cordate/  
17. obcordate/  
18. reniform/  
19. sagittate/  
20. flabellate/  
21. orbicular/  
22. oval/  
23. ensiform/  
24. squarrose/  
25. concave/
- #626. phyllaries <when all alike in 1 row; staminate heads; width>/  
mm wide/
- #627. phyllaries <when all alike in 1 row; staminate heads; length>/  
mm long/
- #628. phyllaries <when all alike in 1 row; staminate heads; surface>/  
1. smooth/  
2. glaucous <waxy covering>/  
3. echinate <stout prickles>/  
4. farinaceous <mealy covering>/  
5. glandular <covered with secretory structures>/  
6. muricate <short, hard protuberances, bumpy>/  
7. resinous <yellowish, sticky exudate>/  
8. scabrous <roughened by short, pointed projections>/  
9. scurfy <mealy; small bran-like scales>/  
10. tuberculate <wartlike, small swellings>/  
11. punctate <dented; pitted; minute impressions or depressions>/  
12. pulverulent <dusty or powdery>/  
13. rugose <wrinkled or venation impressed in the surface>/  
14. sulcate <longitudinal grooves>/  
15. winged <flat extension>/  
16. alveolate <pitted surface with pits separated by thin partitions; honey-combed>/  
17. ridged/  
18. ribbed/

19. pustulate <minute blisters>/  
20. striate <longitudinal blisters>/
- #629. venation <of phyllaries when all alike in 1 row; staminate heads; conspicuousness>/  
1. not apparent/  
2. inconspicuous/  
3. conspicuous/
- #630. venation <of phyllaries when all alike in 1 row; staminate heads; number>/  
1. of 1 vein/  
2. of 2 veins/  
3. of 3 veins/  
4. of 4 or more veins/
- #631. venation <of phyllaries when all alike in 1 row; staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #632. indumentum <of phyllaries when all alike in 1 row; staminate heads>/  
1. glabrous/  
2. scabrous <rough to the touch with short, hard, rigid trichomes>/  
3. scaberulous <minutely scabrous>/  
4. pubescent <soft, short, dense trichomes>/  
5. puberulent <minutely pubescent>/  
6. velutinous <soft, short, dense, straight trichomes; velvety>/  
7. tomentose <soft, short, dense, matted trichomes>/  
8. villous <soft, long, dense, curly, ascending trichomes>/  
9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/  
10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/  
11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/  
12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/  
13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/  
14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/  
15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/  
16. with glandular trichomes/  
17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/  
18. with barbed trichomes/
- #633. apices <of phyllaries when all alike in 1 row; staminate heads; shape>/  
1. aristate/  
2. caudate/  
3. acuminate/  
4. acute/  
5. cuspidate/  
6. mucronate/  
7. mucronulate/  
8. apiculate/  
9. obtuse/  
10. retuse/  
11. emarginate/  
12. attenuate/  
13. obcordate/  
14. truncate/  
15. rounded/  
16. hooked/  
17. spine-tipped/
- #634. apices <of phyllaries when all alike in 1 row; staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #635. margins <of phyllaries when all alike in 1 row; staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #636. margins <of phyllaries when all alike in 1 row; staminate heads>/
1. with fimbriate-ciliate appendages/  
2. with lacerate appendages <e.g., Centaurea>/  
3. with variously shaped appendages <describe>/
- #637. margins <of phyllaries when all alike in 1 row; staminate heads; specific color or colors that serves to distinguish the taxon>/
- #638. margins <of phyllaries when all alike in 1 row; staminate heads>/  
1. entire/  
2. undulate/  
3. sinuate/  
4. crenate/  
5. crenulate/  
6. erose/  
7. serrate/  
8. doubly serrate/  
9. serrulate/  
10. dentate/  
11. denticulate/  
12. incised/  
13. lacerate/  
14. lacinate/  
15. crispate/  
16. ciliate/  
17. spinose/  
18. scarious/  
19. membranous/
- #639. bases <of phyllaries when all alike in 1 row; staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #640. bases <of phyllaries when all alike in 1 row; staminate heads; shape>/  
1. gibbous <e.g., Pectis>/  
2. not gibbous/
- #641. bases <of phyllaries when all alike in 1 row; staminate heads; shape>/  
1. keeled <e.g., Pectis>/  
2. not keeled/
- #642. bases <of phyllaries when all alike in 1 row; staminate heads; enclosure of outermost achenes>/  
1. enclosing outermost achenes/  
2. not enclosing outermost achenes/
- #643. outer phyllaries <when all alike in 2 or more rows; staminate heads; number>/  
1. 1/  
2. 2/  
3. 3/  
4. 4/  
5. 5/  
6. 6/  
7. 7/  
8. 8/  
9. 9/  
10. 10/  
11. 12-20/  
12. 20-30/  
13. 30 or more/
- #644. outer phyllaries <when all alike in 2 or more rows; staminate heads; distinctive general characters that serve to distinguish the taxon>/
- #645. outer phyllaries <when all alike in 2 or more rows; staminate heads; persistence>/  
1. caducous/  
2. deciduous/  
3. persistent <implicit>/
- #646. outer phyllaries <when all alike in 2 or more rows; staminate heads; imbricate>/  
1. imbricate/  
2. not imbricate/

- #647. outer phyllaries <when all alike in 2 or more rows; staminate heads; fusion>/  
 1. free/  
 2. fused/  
 3. fused at bases/
- #648. outer phyllaries <when all alike in 2 or more rows; staminate heads; aspect>/  
 1. appressed/  
 2. ascending/  
 3. spreading/  
 4. reflexed/  
 5. curled/  
 6. deflexed/
- #649. outer phyllaries <when all alike in 2 or more rows; staminate heads; specific color or colors that serves to distinguish the taxon>/
- #650. outer phyllaries <when all alike in 2 or more rows; staminate heads; texture>/  
 1. fleshy/  
 2. succulent/  
 3. cartilaginous <hard and tough, but flexible>/  
 4. chartaceous <papery, opaque and thin>/  
 5. coriaceous <leathery>/  
 6. fibrous <having loose, woody strands>/  
 7. flaccid <lax and weak>/  
 8. herbaceous <soft and succulent>/  
 9. hyaline <thin and translucent or transparent>/  
 10. indurate <hardened>/  
 11. membranous <thin and semi-transparent>/  
 12. scarious <thin and dry>/  
 13. spongy <cellular, sponge-like>/  
 14. subherbaceous/  
 15. foliaceous <leaf-like>/
- #651. outer phyllaries <when all alike in 2 or more rows; staminate heads; shape>/  
 1. subulate/  
 2. acicular/  
 3. filiform/  
 4. linear/  
 5. lanceolate/  
 6. oblanceolate/  
 7. ovate/  
 8. obovate/  
 9. elliptic/  
 10. oblong/  
 11. spatulate/  
 12. runcinate/  
 13. pandurate/  
 14. deltoid/  
 15. obdeltoid/  
 16. cordate/  
 17. obcordate/  
 18. reniform/  
 19. sagittate/  
 20. flabellate/  
 21. orbicular/  
 22. oval/  
 23. ensiform/  
 24. squarrose/  
 25. concave/
- #652. outer phyllaries <when all alike in 2 or more rows; staminate heads; width>/  
 mm wide/
- #653. outer phyllaries <when all alike in 2 or more rows; staminate heads; length>/  
 mm long/
- #654. outer phyllaries <when all alike in 2 or more rows; staminate heads; surface>/  
 1. smooth/  
 2. glaucous <waxy covering>/  
 3. echinate <stout prickles>/  
 4. farinaceous <mealy covering>/  
 5. glandular <covered with secretory structures>/  
 6. muricate <short, hard protuberances, bumpy>/
7. resinous <yellowish, sticky exudate>/  
 8. scabrous <roughened by short, pointed projections>/  
 9. scurfy <mealy; small bran-like scales>/  
 10. tuberculate <warty, small swellings>/  
 11. punctate <dented; pitted; minute impressions or depressions>/  
 12. pulverulent <dusty or powdery>/  
 13. rugose <wrinkled or venation impressed inot the surface>/  
 14. sulcate <longitudinal grooves>/  
 15. winged <flat extension>/  
 16. alveolate <pitted surface with pits separated by thin partitions; honey-comed>/  
 17. ridged/  
 18. ribbed/  
 19. pustulate <minute blisters>/  
 20. striate <longitudinal blisters>/
- #655. venation <of outer phyllaries when all alike in 2 or more rows; staminate heads; conspicuousness>/  
 1. not apparent/  
 2. inconspicuous/  
 3. conspicuous/
- #656. venation <of outer phyllaries when all alike in 2 or more rows; staminate heads; number>/  
 1. of 1 vein/  
 2. of 2 veins/  
 3. of 3 veins/  
 4. of 4 or more veins/
- #657. venation <of outer phyllaries when all alike in 2 or more rows; staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #658. indumentum <of outer phyllaries when all alike in 2 or more rows; staminate heads>/  
 1. glabrous/  
 2. scabrous <rough to the touch with short, hard, rigid trichomes>/  
 3. scaberulous <minutely scabrous>/  
 4. pubescent <soft, short, dense trichomes>/  
 5. puberulent <minutely pubescent>/  
 6. velutinous <soft, short, dense, straight trichomes; velvety>/  
 7. tomentose <soft, short, dense, matted trichomes>/  
 8. villous <soft, long, dense, curly, ascending trichomes>/  
 9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/  
 10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/  
 11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/  
 12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/  
 13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/  
 14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/  
 15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/  
 16. with glandular trichomes/  
 17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/  
 18. with barbed trichomes/
- #659. apices <of outer phyllaries when all alike in 2 or more rows; staminate heads; shape>/  
 1. aristate/  
 2. caudate/  
 3. acuminate/  
 4. acute/  
 5. cuspidate/  
 6. mucronate/  
 7. mucronulate/  
 8. apiculate/  
 9. obtuse/  
 10. retuse/  
 11. emarginate/  
 12. attenuate/  
 13. obcordate/



14. truncate/
  15. rounded/
  16. hooked/
  17. spine-tipped/
- #660. apices <of outer phyllaries when all alike in 2 or more rows; staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #661. margins <of outer phyllaries when all alike in 2 or more rows; staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #662. margins <of outer phyllaries when all alike in 2 or more rows; staminate heads>/
1. with fimbriate-ciliate appendages/
  2. with lacerate appendages <e.g., Centaurea>/
  3. with variously shaped appendages <describe>/
- #663. margins <of outer phyllaries when all alike in 2 or more rows; staminate heads; specific color or colors that serves to distinguish the taxon>/
- #664. margins <of outer phyllaries when all alike in 2 or more rows; staminate heads>/
1. entire/
  2. undulate/
  3. sinuate/
  4. crenate/
  5. crenulate/
  6. erose/
  7. serrate/
  8. doubly serrate/
  9. serrulate/
  10. dentate/
  11. denticulate/
  12. incised/
  13. lacerate/
  14. lacinate/
  15. crispate/
  16. ciliate/
  17. spinose/
  18. scarious/
  19. membranous/
- #665. bases <of outer phyllaries when all alike in 2 or more rows; staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #666. bases <of outer phyllaries when all alike in 2 or more rows; staminate heads; shape>/
1. gibbous <e.g., Pectis>/
  2. not gibbous/
- #667. bases <of outer phyllaries when all alike in 2 or more rows; staminate heads; shape>/
1. keeled <e.g., Pectis>/
  2. not keeled/
- #668. inner phyllaries <when all alike in 2 or more rows; staminate heads; number>/
1. 1/
  2. 2/
  3. 3/
  4. 4/
  5. 5/
  6. 6/
  7. 7/
  8. 8/
  9. 9/
  10. 10/
  11. 12-20/
  12. 20-30/
  13. 30 or more/
- #669. inner phyllaries <when all alike in 2 or more rows; staminate heads; distinctive general characters that serve to distinguish the taxon>/
- #670. inner phyllaries <when all alike in 2 or more rows; staminate heads; persistence>/
1. caducous/
  2. deciduous/
  3. persistent <implicit>/
- #671. inner phyllaries <when all alike in 2 or more rows; staminate heads; imbricate>/
1. imbricate/
  2. not imbricate/
- #672. inner phyllaries <when all alike in 2 or more rows; staminate heads; fusion>/
1. free/
  2. fused/
  3. fused at bases/
- #673. inner phyllaries <when all alike in 2 or more rows; staminate heads; aspect>/
1. appressed/
  2. ascending/
  3. spreading/
  4. reflexed/
  5. curled/
  6. deflexed/
- #674. inner phyllaries <when all alike in 2 or more rows; staminate heads; specific color or colors that serves to distinguish the taxon>/
- #675. inner phyllaries <when all alike in 2 or more rows; staminate heads; texture>/
1. fleshy/
  2. succulent/
  3. cartilaginous <hard and tough, but flexible>/
  4. chartaceous <papery, opaque and thin>/
  5. coriaceous <leathery>/
  6. fibrous <having loose, woody strands>/
  7. flaccid <lax and weak>/
  8. herbaceous <soft and succulent>/
  9. hyaline <thin and translucent or transparent>/
  10. indurate <hardened>/
  11. membranous <thin and semi-transparent>/
  12. scarious <thin and dry>/
  13. spongy <cellular, sponge-like>/
  14. subherbaceous/
  15. foliaceous <leaf-like>/
- #676. inner phyllaries <when all alike in 2 or more rows; staminate heads; shape>/
1. subulate/
  2. acicular/
  3. filiform/
  4. linear/
  5. lanceolate/
  6. oblanceolate/
  7. ovate/
  8. obovate/
  9. elliptic/
  10. oblong/
  11. spatulate/
  12. runcinate/
  13. pandurate/
  14. deltoid/
  15. obdeltoid/
  16. cordate/
  17. obcordate/
  18. reniform/
  19. sagittate/
  20. flabellate/
  21. orbicular/
  22. oval/
  23. ensiform/
  24. squarrose/
  25. concave/
- #677. inner phyllaries <when all alike in 2 or more rows; staminate heads; width>/
- mm wide/
- #678. inner phyllaries <when all alike in 2 or more rows; staminate heads; length>/

- mm long/
- #679. inner phyllaries <when all alike in 2 or more rows; staminate heads; surface>/
1. smooth/
  2. glaucous <waxy covering>/
  3. echinate <stout prickles>/
  4. farinaceous <mealy covering>/
  5. glandular <covered with secretory structures>/
  6. muricate <short, hard protuberances, bumpy>/
  7. resinous <yellowish, sticky exudate>/
  8. scabrous <roughened by short, pointed projections>/
  9. scurfy <mealy; small bran-like scales>/
  10. tuberculate <warty, small swellings>/
  11. punctate <dented; pitted; minute impressions or depressions>/
  12. pulverulent <dusty or powdery>/
  13. rugose <wrinkled or venation impressed in the surface>/
  14. sulcate <longitudinal grooves>/
  15. winged <flat extension>/
  16. alveolate <pitted surface with pits separated by thin partitions; honey-combed>/
  17. ridged/
  18. ribbed/
  19. pustulate <minute blisters>/
  20. striate <longitudinal blisters>/
- #680. venation <of inner phyllaries when all alike in 2 or more rows; staminate heads; conspicuousness>/
1. not apparent/
  2. inconspicuous/
  3. conspicuous/
- #681. venation <of inner phyllaries when all alike in 2 or more rows; taminate heads; number>/
1. of 1 vein/
  2. of 2 veins/
  3. of 3 veins/
  4. of 4 or more veins/
- #682. venation <of inner phyllaries when all alike in 2 or more rows; staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #683. indumentum <of inner phyllaries when all alike in 2 or more rows; staminate heads>/
1. glabrous/
  2. scabrous <rough to the touch with short, hard, rigid trichomes>/
  3. scaberulous <minutely scabrous>/
  4. pubescent <soft, short, dense trichomes>/
  5. puberulent <minutely pubescent>/
  6. velutinous <soft, short, dense, straight trichomes; velvety>/
  7. tomentose <soft, short, dense, matted trichomes>/
  8. villous <soft, long, dense, curly, ascending trichomes>/
  9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/
  10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/
  11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/
  12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/
  13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/
  14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/
  15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/
  16. with glandular trichomes/
  17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/
  18. with barbed trichomes/
- #684. apices <of inner phyllaries when all alike in 2 or more rows; staminate heads; shape>/
1. aristate/
  2. caudate/
  3. acuminate/
  4. acute/
  5. cuspidate/
  6. mucronate/
  7. mucronulate/
  8. apiculate/
  9. obtuse/
  10. retuse/
  11. emarginate/
  12. attenuate/
  13. obcordate/
  14. truncate/
  15. rounded/
  16. hooked/
  17. spine-tipped/
- #685. apices <of inner phyllaries when all alike in 2 or more rows; staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #686. margins <of inner phyllaries when all alike in 2 or more rows; staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #687. margins <of inner phyllaries when all alike in 2 or more rows; staminate heads>/
1. with fimbriate-ciliate appendages/
  2. with lacerate appendages <e.g., Centaurea>/
  3. with variously shaped appendages <describe>/
- #688. margins <of inner phyllaries when all alike in 2 or more rows; staminate heads; specific color or colors that serves to distinguish the taxon>/
- #689. margins <of inner phyllaries when all alike in 2 or more rows; staminate heads>/
1. entire/
  2. undulate/
  3. sinuate/
  4. crenate/
  5. crenulate/
  6. erose/
  7. serrate/
  8. doubly serrate/
  9. serrulate/
  10. dentate/
  11. denticulate/
  12. incised/
  13. lacerate/
  14. lacinate/
  15. crispate/
  16. ciliate/
  17. spinose/
  18. scarious/
  19. membranous/
- #690. bases <of inner phyllaries when all alike in 2 or more rows; staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #691. bases <of inner phyllaries when all alike in 2 or more rows; staminate heads; shape>/
1. gibbous <e.g., Pectis>/
  2. not gibbous/
- #692. bases <of inner phyllaries when all alike in 2 or more rows; staminate heads; shape>/
1. keeled <e.g., Pectis>/
  2. not keeled/
- #693. bases <of inner phyllaries when all alike in 2 or more rows; staminate heads; enclosure of outermost achenes>/
1. enclosing outermost achenes/
  2. not enclosing outermost achenes/
- #694. outer phyllaries <when of 2 or more forms; staminate heads; number>/
1. 1/
  2. 2/
  3. 3/
  4. 4/
  5. 5/

6. 6/
  7. 7/
  8. 8/
  9. 9/
  10. 10/
  11. 12 -20/
  12. 20-30/
  13. 30 or more/
- #695. outer phyllaries <when of 2 or more forms; staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #696. outer phyllaries <when of 2 or more forms; staminate heads; persistence>/
1. caducous/
  2. deciduous/
  3. persistent <implicit>/
- #697. outer phyllaries <when of 2 or more forms; staminate heads; imbricate>/
1. imbricate/
  2. not imbricate/
- #698. outer phyllaries <when of 2 or more forms; staminate heads; fusion>/
1. free/
  2. fused/
  3. fused at bases/
- #699. outer phyllaries <when of 2 or more forms; staminate heads; aspect>/
1. appressed/
  2. ascending/
  3. spreading/
  4. reflexed/
  5. curled/
  6. deflexed/
- #700. outer phyllaries <when of 2 or more forms; staminate heads; specific color or colors that serves to distinguish the taxon>/
- #701. outer phyllaries <when of 2 or more forms; staminate heads; texture>/
1. fleshy/
  2. succulent/
  3. cartilaginous <hard and tough, but flexible>/
  4. chartaceous <papery, opaque and thin>/
  5. coriaceous <leathery>/
  6. fibrous <having loose, woody strands>/
  7. flaccid <lax and weak>/
  8. herbaceous <soft and succulent>/
  9. hyaline <thin and translucent or transparent>/
  10. indurate <hardened>/
  11. membranous <thin and semi-transparent>/
  12. scarious <thin and dry>/
  13. spongy <cellular, sponge-like>/
  14. subherbaceous/
  15. foliaceous <leaf-like>/
- #702. outer phyllaries <when of 2 or more forms; staminate heads; shape>/
1. subulate/
  2. acicular/
  3. filiform/
  4. linear/
  5. lanceolate/
  6. oblanceolate/
  7. ovate/
  8. obovate/
  9. elliptic/
  10. oblong/
  11. spatulate/
  12. runcinate/
  13. pandurate/
  14. deltoid/
  15. obdeltoid/
  16. cordate/
  17. obcordate/
  18. reniform/
19. sagittate/
  20. flabellate/
  21. orbicular/
  22. oval/
  23. ensiform/
  24. squarrose/
  25. concave/
- #703. outer phyllaries <when of 2 or more forms; staminate heads; width>/
- mm wide/
- #704. outer phyllaries <when of 2 or more forms; staminate heads; length>/
- mm long/
- #705. outer phyllaries <when of 2 or more forms; staminate heads; surface>/
1. smooth/
  2. glaucous <waxy covering>/
  3. echinate <stout prickles>/
  4. farinaceous <mealy covering>/
  5. glandular <covered with secretory structures>/
  6. muricate <short, hard protuberances, bumpy>/
  7. resinous <yellowish, sticky exudate>/
  8. scabrous <roughened by short, pointed projections>/
  9. scurfy <mealy; small bran-like scales>/
  10. tuberculate <wart, small swellings>/
  11. punctate <dented; pitted; minute impressions or depressions>/
  12. pulverulent <dusty or powdery>/
  13. rugose <wrinkled or venation impressed in the surface>/
  14. sulcate <longitudinal grooves>/
  15. winged <flat extension>/
  16. alveolate <pitted surface with pits separated by thin partitions; honey-combed>/
  17. ridged/
  18. ribbed/
  19. pustulate <minute blisters>/
  20. striate <longitudinal blisters>/
- #706. venation <of outer phyllaries when of 2 or more forms; staminate heads; conspicuousness>/
1. not apparent/
  2. inconspicuous/
  3. conspicuous/
- #707. venation <of outer phyllaries when of 2 or more forms; staminate heads; number>/
1. of 1 vein/
  2. of 2 veins/
  3. of 3 veins/
  4. of 4 or more veins/
- #708. venation <of outer phyllaries when of 2 or more forms; staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #709. indumentum <of outer phyllaries when of 2 or more forms; staminate heads>/
1. glabrous/
  2. scabrous <rough to the touch with short, hard, rigid trichomes>/
  3. scaberulous <minutely scabrous>/
  4. pubescent <soft, short, dense trichomes>/
  5. puberulent <minutely pubescent>/
  6. velutinous <soft, short, dense, straight trichomes; velvety>/
  7. tomentose <soft, short, dense, matted trichomes>/
  8. villous <soft, long, dense, curly, ascending trichomes>/
  9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/
  10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/
  11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/
  12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/
  13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/

14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/
  15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/
  16. with glandular trichomes/
  17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/
  18. with barbed trichomes/
- #710. apices <of outer phyllaries when of 2 or more forms; staminate heads; shape>/
1. aristate/
  2. caudate/
  3. acuminate/
  4. acute/
  5. cuspidate/
  6. mucronate/
  7. mucronulate/
  8. apiculate/
  9. obtuse/
  10. retuse/
  11. emarginate/
  12. attenuate/
  13. obcordate/
  14. truncate/
  15. rounded/
  16. hooked/
  17. spine-tipped/
- #711. apices <of outer phyllaries when of 2 or more forms; staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #712. margins <of outer phyllaries when of 2 or more forms; staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #713. margins <of outer phyllaries when of 2 or more forms; staminate heads>/
1. with fimbriate-ciliate appendages/
  2. with lacerate appendages <e.g., Centaurea>/
  3. with variously shaped appendages <describe>/
- #714. margins <of outer phyllaries when of 2 or more forms; staminate heads; specific color or colors that serves to distinguish the taxon>/
- #715. margins <of outer phyllaries when of 2 or more forms; staminate heads>/
1. entire/
  2. undulate/
  3. sinuate/
  4. crenate/
  5. crenulate/
  6. erose/
  7. serrate/
  8. doubly serrate/
  9. serrulate/
  10. dentate/
  11. denticulate/
  12. incised/
  13. lacerate/
  14. lacinate/
  15. crispate/
  16. ciliate/
  17. spinose/
  18. scariosus/
  19. membranous/
- #716. bases <of outer phyllaries when of 2 or more forms; staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #717. bases <of outer phyllaries when of 2 or more forms; staminate heads; shape>/
1. gibbous <e.g., Pectis>/
  2. not gibbous/
- #718. bases <of outer phyllaries when of 2 or more forms; staminate heads; shape>/
1. keeled <e.g., Pectis>/
  2. not keeled/
- #719. inner phyllaries <when of 2 or more forms; staminate heads; number>/
1. 1/
  2. 2/
  3. 3/
  4. 4/
  5. 5/
  6. 6/
  7. 7/
  8. 8/
  9. 9/
  10. 10/
  11. 12 -20/
  12. 20-30/
  13. 30 or more/
- #720. inner phyllaries <when of 2 or more forms; staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #721. inner phyllaries <when of 2 or more forms; staminate heads; persistence>/
1. caducous/
  2. deciduous/
  3. persistent <implicit>/
- #722. inner phyllaries <when of 2 or more forms; staminate heads; imbricate>/
1. imbricate/
  2. not imbricate/
- #723. inner phyllaries <when of 2 or more forms; staminate heads; fusion>/
1. free/
  2. fused/
  3. fused at bases/
- #724. inner phyllaries <when of 2 or more forms; staminate heads; aspect>/
1. appressed/
  2. ascending/
  3. spreading/
  4. reflexed/
  5. curled/
  6. deflexed/
- #725. inner phyllaries <when of 2 or more forms; staminate heads; specific color or colors that serves to distinguish the taxon>/
- #726. inner phyllaries <when of 2 or more forms; staminate heads; texture>/
1. fleshy/
  2. succulent/
  3. cartilaginous <hard and tough, but flexible>/
  4. chartaceous <papery, opaque and thin>/
  5. coriaceous <leathery>/
  6. fibrous <having loose, woody strands>/
  7. flaccid <lax and weak>/
  8. herbaceous <soft and succulent>/
  9. hyaline <thin and translucent or transparent>/
  10. indurate <hardened>/
  11. membranous <thin and semi-transparent>/
  12. scarious <thin and dry>/
  13. spongy <cellular, sponge-like>/
  14. subherbaceous/
  15. foliaceous <leaf-like>/
- #727. inner phyllaries <when of 2 or more forms; staminate heads; shape>/
1. subulate/
  2. acicular/
  3. filiform/
  4. linear/
  5. lanceolate/
  6. oblanceolate/
  7. ovate/
  8. obovate/
  9. elliptic/

10. oblong/
  11. spatulate/
  12. runcinate/
  13. pandurate/
  14. deltoid/
  15. obdeltoid/
  16. cordate/
  17. obcordate/
  18. reniform/
  19. sagittate/
  20. flabellate/
  21. orbicular/
  22. oval/
  23. ensiform/
  24. squarrose/
  25. concave/
- #728. inner phyllaries <when of 2 or more forms; staminate heads; width>/  
mm wide/
- #729. inner phyllaries <when of 2 or more forms; staminate heads; length>/  
mm long/
- #730. inner phyllaries <when of 2 or more forms; staminate heads; surface>/
1. smooth/
  2. glaucous <waxy covering>/
  3. echinate <stout prickles>/
  4. farinaceous <mealy covering>/
  5. glandular <covered with secretory structures>/
  6. muricate <short, hard protuberances, bumpy>/
  7. resinous <yellowish, sticky exudate>/
  8. scabrous <roughened by short, pointed projections>/
  9. scurfy <mealy; small bran-like scales>/
  10. tuberculate <wartlike, small swellings>/
  11. punctate <dented; pitted; minute impressions or depressions>/
  12. pulverulent <dusty or powdery>/
  13. rugose <wrinkled or venation impressed in the surface>/
  14. sulcate <longitudinal grooves>/
  15. winged <flat extension>/
  16. alveolate <pitted surface with pits separated by thin partitions; honey-combed>/
  17. ridged/
  18. ribbed/
  19. pustulate <minute blisters>/
  20. striate <longitudinal blisters>/
- #731. venation <of inner phyllaries when of 2 or more forms; staminate heads; conspicuousness>/
1. not apparent/
  2. inconspicuous/
  3. conspicuous/
- #732. venation <of inner phyllaries when of 2 or more forms; staminate heads; number>/
1. of 1 vein/
  2. of 2 veins/
  3. of 3 veins/
  4. of 4 or more veins/
- #733. venation <of inner phyllaries when of 2 or more forms; staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #734. indumentum <of inner phyllaries when of 2 or more forms; staminate heads>/
1. glabrous/
  2. scabrous <rough to the touch with short, hard, rigid trichomes>/
  3. scaberulous <minutely scabrous>/
  4. pubescent <soft, short, dense trichomes>/
  5. puberulent <minutely pubescent>/
  6. velutinous <soft, short, dense, straight trichomes; velvety>/
  7. tomentose <soft, short, dense, matted trichomes>/
  8. villous <soft, long, dense, curly, ascending trichomes>/
  9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/
10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/
11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/
12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/
13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/
14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/
15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/
16. with glandular trichomes/
17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/
18. with barbed trichomes/
- #735. apices <of inner phyllaries when of 2 or more forms; staminate heads; shape>/
1. aristate/
  2. caudate/
  3. acuminate/
  4. acute/
  5. cuspidate/
  6. mucronate/
  7. mucronulate/
  8. apiculate/
  9. obtuse/
  10. retuse/
  11. emarginate/
  12. attenuate/
  13. obcordate/
  14. truncate/
  15. rounded/
  16. hooked/
  17. spine-tipped/
- #736. apices <of inner phyllaries when of 2 or more forms; staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #737. margins <of inner phyllaries when of 2 or more forms; staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #738. margins <of inner phyllaries when of 2 or more forms; staminate heads>/
1. with fimbriate-ciliate appendages/
  2. with lacerate appendages <e.g., Centaurea>/
  3. with variously shaped appendages <describe>/
- #739. margins <of inner phyllaries when of 2 or more forms; staminate heads; specific color or colors that serves to distinguish the taxon>/
- #740. margins <of inner phyllaries when of 2 or more forms; staminate heads>/
1. entire/
  2. undulate/
  3. sinuate/
  4. crenate/
  5. crenulate/
  6. erose/
  7. serrate/
  8. doubly serrate/
  9. serrulate/
  10. dentate/
  11. denticulate/
  12. incised/
  13. lacerate/
  14. lacinate/
  15. crispate/
  16. ciliate/
  17. spinose/
  18. scarious/
  19. membranous/
- #741. bases <of inner phyllaries when of 2 or more forms; staminate heads; distinctive, general characters that serve

- to distinguish the taxon>/
- #742. bases <of inner phyllaries when of 2 or more forms; staminate heads; shape>/  
 1. gibbous <e.g., Pectis>/  
 2. not gibbous/
- #743. bases <of inner phyllaries when of 2 or more forms; staminate heads; shape>/  
 1. keeled <e.g., Pectis>/  
 2. not keeled/
- #744. bases <of inner phyllaries when of 2 or more forms; staminate heads; enclosure of outermost achenes>/  
 1. enclosing outermost achenes/  
 2. not enclosing outermost achenes/
- #745. ray florets <of staminate heads; presence>/  
 1. present/  
 2. absent/
- #746. ray florets <of staminate heads; number>/  
 1. 2/  
 2. 3/  
 3. 4/  
 4. 5/  
 5. 6/  
 6. 7/  
 7. 8/  
 8. 9/  
 9. 10-20/  
 10. 20 or more/
- #747. ray florets <of staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #748. ray florets <of staminate heads; rows>/  
 1. in 1 row/  
 2. in 2 rows/  
 3. in 3 or more rows/
- #749. ray florets <of staminate heads; number of florets per row, when in more than 1 whorl>/
- #750. ray florets <of staminate heads; sexuality>  
 <MANDATORY>/  
 1. perfect/  
 2. pistillate/  
 3. staminate/  
 4. neuter/  
 5. perfect, but functionally pistillate/  
 6. perfect, but functionally staminate/
- #751. ray florets <of staminate heads; fertility; producing achenes>/  
 1. fertile/  
 2. sterile/
- #752. pappus <of ray florets; staminate heads; presence>/  
 1. absent/  
 2. present; in 1 whorl/  
 3. present; in 2 whorls <double>/
- #753. pappus <of ray florets; staminate heads when in 1 whorl; morphological forms>/  
 1. of awns/  
 2. of scales/  
 3. of teeth/  
 4. of appressed teeth/  
 5. of capillary hairs/  
 6. of capillary bristles/  
 7. of bristles/  
 8. of scabrous bristles/  
 9. of stiff bristles/  
 10. of plumose bristles/  
 11. coroniform/  
 12. of barbellate bristles/  
 13. of scarious scales/  
 14. of smooth bristles/  
 15. of hairs/  
 16. an adaxial auricle <e.g., Anthemis>/
17. of bristlelike scales/  
 18. of stiff scales/  
 19. of subclavate hairs/  
 20. of subulate hairs <awl-shaped>/  
 21. a crenulate rim <e.g., Heliopsis>/  
 22. of barbellate awns/  
 23. of retrorsely hispid awns/  
 24. of fimbriate awns/  
 25. of elongate awns/  
 26. of serrulate awns/
- #754. pappus <of ray florets; staminate heads; number of parts>/  
 1. 1/  
 2. 2/  
 3. 3/  
 4. 4/  
 5. 5/  
 6. 6/  
 7. 7/  
 8. 8/  
 9. 9/  
 10. 10/  
 11. 11/  
 12. 12 or more/  
 13. numerous <number, if countable>/
- #755. pappus <of ray florets when in 1 whorl; staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #756. pappus <of ray florets when in 1 whorl; staminate heads; persistence>/  
 1. caducous/  
 2. persistent in fruit/  
 3. not persistent in fruit/
- #757. pappus <of ray florets when in 1 whorl; staminate heads; fusion>/  
 1. free/  
 2. fused/  
 3. fused at bases/
- #758. pappus <of ray florets when in 1 whorl; staminate heads; aspect>/  
 1. appressed/  
 2. ascending/  
 3. spreading/  
 4. reflexed/  
 5. curled/
- #759. pappus <of ray florets when in 1 whorl; staminate heads; specific color or colors that serves to distinguish the taxon>/
- #760. pappus <of ray florets when in 1 whorl; staminate heads; nature>/  
 1. fragile/  
 2. stout/
- #761. pappus <of ray florets when in 1 whorl; staminate heads; nature>/  
 1. slender/  
 2. thick/  
 3. flattened on outer sides <e.g., Brickellia>/
- #762. pappus <of ray florets when in 1 whorl; staminate heads; width>/  
 mm wide/
- #763. pappus <of ray florets when in 1 whorl; staminate heads; equality in length>/  
 1. all equal in length/  
 2. unequal in length/
- #764. pappus <of ray florets when in 1 whorl; staminate heads; length>/  
 mm long/
- #765. indumentum <of pappus of ray florets when in 1 whorl; staminate heads>/

1. glabrous/
  2. scabrous <rough to the touch with short, hard, rigid trichomes>/
  3. scaberulous <minutely scabrous>/
  4. pubescent <soft, short, dense trichomes>/
  5. puberulent <minutely pubescent>/
  6. velutinous <soft, short, dense, straight trichomes; velvety>/
  7. tomentose <soft, short, dense, matted trichomes>/
  8. villous <soft, long, dense, curly, ascending trichomes>/
  9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/
  10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/
  11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/
  12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/
  13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/
  14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/
  15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/
  16. with glandular trichomes/
  17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/
  18. with barbed trichomes/
- #766. apices <of pappus of ray florets when in 1 whorl; staminate heads; shape>/
1. rounded/
  2. obtuse/
  3. acute/
  4. acuminate/
- #767. apices <of pappus of ray florets when in 1 whorl; staminate heads>/
1. with midribs excurrent as awns/
  2. with midribs not excurrent as awns/
- #768. margins <of pappus of ray florets when in 1 whorl; staminate heads>/
1. entire/
  2. undulate/
  3. sinuate/
  4. crenate/
  5. crenulate/
  6. erose/
  7. serrate/
  8. doubly serrate/
  9. serrulate/
  10. dentate/
  11. denticulate/
  12. incised/
  13. lacerate/
  14. lacinate/
  15. crispate/
  16. ciliate/
  17. spinose/
  18. scarious/
  19. membranous/
- #769. bases <of pappus of ray florets when in 1 whorl; staminate heads; nature>/
1. wide/
  2. narrow/
- #770. bases <of pappus of ray florets when in 1 whorl; staminate heads; nature>/
1. thick/
  2. thin/
- #771. bases <of pappus of ray florets when in 1 whorl; staminate heads; nature>/
1. straight/
  2. curved/
- #772. outer pappus <of ray florets when in 2 whorls; staminate heads; morphological forms>/
1. of awns/
  2. of scales/
  3. of teeth/
  4. of appressed teeth/
  5. of capillary hairs/
  6. of capillary bristles/
  7. of bristles/
  8. of scabrous bristles/
  9. of stiff bristles/
  10. of plumose bristles/
  11. coroniform/
  12. of barbellate bristles/
  13. of scarious scales/
  14. of smooth bristles/
  15. of hairs/
  16. an adaxial auricle <e.g., Anthemis>/
  17. of bristlelike scales/
  18. of stiff scales/
  19. of subclavate hairs/
  20. of subulate hairs <awl-shaped>/
  21. a crenulate rim <e.g., Heliopsis>/
  22. of barbellate awns/
  23. of retrorsely hispid awns/
  24. of fimbriate awns/
  25. of elongate awns/
  26. of serrulate awns/
- #773. outer pappus <of ray florets when in 2 whorls; staminate heads; number of parts>/
1. 1/
  2. 2/
  3. 3/
  4. 4/
  5. 5/
  6. 6/
  7. 7/
  8. 8/
  9. 9/
  10. 10/
  11. 11/
  12. 12 or more/
  13. numerous <number, if countable>/
- #774. outer pappus <of ray florets when in 2 whorls; staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #775. outer pappus <of ray florets when in 2 whorls; staminate heads; persistence>/
1. caducous/
  2. persistent in fruit/
  3. not persistent in fruit/
- #776. outer pappus <of ray florets when in 2 whorls; staminate heads; fusion>/
1. free/
  2. fused/
  3. fused at bases/
- #777. outer pappus <of ray florets when in 2 whorls; staminate heads; aspect>/
1. appressed/
  2. ascending/
  3. spreading/
  4. reflexed/
  5. curled/
- #778. outer pappus <of ray florets when in 2 whorls; staminate heads; specific color or colors that serves to distinguish the taxon>/
- #779. outer pappus <of ray florets when in 2 whorls; staminate heads; nature>/
1. fragile/
  2. stout/
- #780. outer pappus <of ray florets when in 2 whorls; staminate heads; nature>/
1. slender/
  2. thick/
  3. flattened on outer sides <e.g., Brickellia>/

- #781. outer pappus <of ray florets when in 2 whorls; staminate heads; width>/  
mm wide/
- #782. outer pappus <of ray florets when in 2 whorls; staminate heads; equality in length>/  
1. all equal in length/  
2. unequal in length/
- #783. outer pappus <of ray florets when in 2 whorls; staminate heads; length>/  
mm long/
- #784. indumentum <of outer pappus of ray florets when in 2 whorls; staminate heads>/  
1. glabrous/  
2. scabrous <rough to the touch with short, hard, rigid trichomes>/  
3. scaberulous <minutely scabrous>/  
4. pubescent <soft, short, dense trichomes>/  
5. puberulent <minutely pubescent>/  
6. velutinous <soft, short, dense, straight trichomes; velvety>/  
7. tomentose <soft, short, dense, matted trichomes>/  
8. villous <soft, long, dense, curly, ascending trichomes>/  
9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/  
10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/  
11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/  
12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/  
13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/  
14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/  
15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/  
16. with glandular trichomes/  
17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/  
18. with barbed trichomes/
- #785. apices <of outer pappus of ray florets when in 2 whorls; staminate heads; shape>/  
1. rounded/  
2. obtuse/  
3. acute/  
4. acuminate/
- #786. apices <of outer pappus of ray florets when in 2 whorls; staminate heads>/  
1. with midribs excurrent as awns/  
2. midribs not excurrent as awns/
- #787. margins <of outer pappus of ray florets when in 2 whorls; staminate heads>/  
1. entire/  
2. undulate/  
3. sinuate/  
4. crenate/  
5. crenulate/  
6. erose/  
7. serrate/  
8. doubly serrate/  
9. serrulate/  
10. dentate/  
11. denticulate/  
12. incised/  
13. lacerate/  
14. lacinate/  
15. crispate/  
16. ciliate/  
17. spinose/  
18. scariosus/  
19. membranous/
- #788. bases <of outer pappus of ray florets when in 2 whorls; staminate heads; nature>/  
1. wide/  
2. narrow/
- #789. bases <of outer pappus of ray florets when in 2 whorls; staminate heads; nature>/  
1. thick/  
2. thin/
- #790. bases <of outer pappus of ray florets when in 2 whorls; staminate heads; nature>/  
1. straight/  
2. curved/
- #791. inner pappus <of ray florets when in 2 whorls; staminate heads; morphological forms>/  
1. of awns/  
2. of scales/  
3. of teeth/  
4. of appressed teeth/  
5. of capillary hairs/  
6. of capillary bristles/  
7. of bristles/  
8. of scabrous bristles/  
9. of stiff bristles/  
10. of plumose bristles/  
11. coroniform/  
12. of barbellate bristles/  
13. of scariosus scales/  
14. of smooth bristles/  
15. of hairs/  
16. an adaxial auricle <e.g., Anthemis>/  
17. of bristlelike scales/  
18. of stiff scales/  
19. of subclavate hairs/  
20. of subulate hairs <awl-shaped>/  
21. a crenulate rim <e.g., Heliopsis>/  
22. of barbellate awns/  
23. of retrorsely hispid awns/  
24. of fimbriate awns/  
25. of elongate awns/  
26. of serrulate awns/
- #792. inner pappus <of ray florets when in 2 whorls; staminate heads; number of parts>/  
1. 1/  
2. 2/  
3. 3/  
4. 4/  
5. 5/  
6. 6/  
7. 7/  
8. 8/  
9. 9/  
10. 10/  
11. 11/  
12. 12 or more/  
13. numerous <number, if countable>/
- #793. inner pappus <of ray florets when in 2 whorls; staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #794. inner pappus <of ray florets when in 2 whorls; staminate heads; persistence>/  
1. caducous/  
2. persistent in fruit/  
3. not persistent in fruit/
- #795. inner pappus <of ray florets when in 2 whorls; staminate heads; fusion>/  
1. free/  
2. fused/  
3. fused at bases/
- #796. inner pappus <of ray florets when in 2 whorls; staminate heads; aspect>/  
1. appressed/  
2. ascending/  
3. spreading/  
4. reflexed/  
5. curled/



- #797. inner pappus <of ray florets when in 2 whorls; staminate heads; specific color or colors that serves to distinguish the taxon>/
- #798. inner pappus <of ray florets when in 2 whorls; staminate heads; nature>/  
 1. fragile/  
 2. stout/
- #799. inner pappus <of ray florets when in 2 whorls; staminate heads; nature>/  
 1. slender/  
 2. thick/  
 3. flattened on outer sides <e.g., Brickellia>/
- #800. inner pappus <of ray florets when in 2 whorls; staminate heads; width>/  
 mm wide/
- #801. inner pappus <of ray florets when in 2 whorls; staminate heads; equality in length>/  
 1. all equal in length/  
 2. unequal in length/
- #802. inner pappus <of ray florets when in 2 whorls; staminate heads; length>/  
 mm long/
- #803. indumentum <of inner pappus of ray florets when in 2 whorls; staminate heads>/  
 1. glabrous/  
 2. scabrous <rough to the touch with short, hard, rigid trichomes>/  
 3. scaberulous <minutely scabrous>/  
 4. pubescent <soft, short, dense trichomes>/  
 5. puberulent <minutely pubescent>/  
 6. velutinous <soft, short, dense, straight trichomes; velvety>/  
 7. tomentose <soft, short, dense, matted trichomes>/  
 8. villous <soft, long, dense, curly, ascending trichomes>/  
 9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/  
 10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/  
 11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/  
 12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/  
 13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/  
 14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/  
 15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/  
 16. with glandular trichomes/  
 17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/  
 18. with barbed trichomes/
- #804. apices <of inner pappus of ray florets when in 2 whorls; staminate heads; shape>/  
 1. rounded/  
 2. obtuse/  
 3. acute/  
 4. acuminate/
- #805. apices <of inner pappus of ray florets when in 2 whorls; staminate heads>/  
 1. with midribs excurrent as awns/  
 2. with midribs not excurrent as awns/
- #806. margins <of inner pappus of ray florets when in 2 whorls; staminate heads>/  
 1. entire/  
 2. undulate/  
 3. sinuate/  
 4. crenate/  
 5. crenulate/  
 6. erose/  
 7. serrate/  
 8. doubly serrate/
9. serrulate/  
 10. dentate/  
 11. denticulate/  
 12. incised/  
 13. lacerate/  
 14. lacinate/  
 15. crispate/  
 16. ciliate/  
 17. spinose/  
 18. scarious/  
 19. membranous/
- #807. bases <of inner pappus of ray florets when in 2 whorls; staminate heads; nature>/  
 1. wide/  
 2. narrow/
- #808. bases <of inner pappus of ray florets when in 2 whorls; staminate heads; nature>/  
 1. thick/  
 2. thin/
- #809. bases <of inner pappus of ray florets when in 2 whorls; staminate heads; nature>/  
 1. straight/  
 2. curved/
- #810. corollas <of ray florets of staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #811. corollas <of ray florets of staminate heads; differentiation>/  
 1. differentiated into limbs and tubes <implicit>/  
 2. not differentiated, limbs absent and tubes present/  
 3. not differentiated, limbs present and tubes absent <e.g., Zinnia>/
- #812. corollas <of ray florets of staminate heads; fusion of lobes>/  
 1. not lobed/  
 2. 2-lobed/  
 3. shallowly 3-lobed/  
 4. deeply 3-lobed/  
 5. 4-lobed/  
 6. 5-lobed/
- #813. corollas <of ray florets of staminate heads; persistence>/  
 1. cauducous/  
 2. persistent at maturity/  
 3. deciduous at maturity/
- #814. corollas <of ray florets of staminate heads; aspect>/  
 1. erect/  
 2. ascending/  
 3. spreading/  
 4. reflexed/  
 5. curled/
- #815. corollas <of ray florets of staminate heads; specific color or colors that serves to distinguish the taxon>/
- #816. corollas <of ray florets of staminate heads; limb texture>/  
 1. membranous/  
 2. fleshy/  
 3. succulent/  
 4. cartilaginous <hard and tough, but flexible>/  
 5. chartaceous <papery, opaque and thin, e.g., Hymenoxys>/  
 6. coriaceous <leathery>/  
 7. flaccid <lax and weak>/  
 8. herbaceous <soft and succulent>/  
 9. hyaline <thin and translucent or transparent>/  
 10. indurate <hardened>/  
 11. scarious <thin and dry>/
- #817. corollas <of ray florets of staminate heads; limb shape>/  
 1. spatulate/  
 2. cucullate/  
 3. linear/  
 4. emarginate/

5. bifid/
  6. rhomboid/
  7. deltoid/
  8. triangular/
  9. ovate/
  10. lanceolate/
  11. oblanceolate/
  12. obovate/
  13. oblong/
  14. orbicular/
- #818. corollas <of ray florets of staminate heads; width> /  
mm wide/
- #819. corollas <of ray florets of staminate heads; length  
including length of tube> /  
mm long/
- #820. corollas <of ray florets of staminate heads; venation> /  
1. 3-veined/  
2. 4-veined/  
3. 5-veined/  
4. many veined/
- #821. indumentum <of corollas of ray florets; staminate  
heads> /  
1. glabrous/  
2. scabrous <rough to the touch with short, hard, rigid  
trichomes> /  
3. scaberrulous <minutely scabrous> /  
4. pubescent <soft, short, dense trichomes> /  
5. puberulent <minutely pubescent> /  
6. velutinous <soft, short, dense, straight trichomes;  
velvety> /  
7. tomentose <soft, short, dense, matted trichomes> /  
8. villous <soft, long, dense, curly, ascending trichomes> /  
9. sericeous <soft, long, dense or sparse, appressed,  
straight trichomes; silky> /  
10. lanate <soft, long, dense, matted, ascending, curly  
trichomes; woolly> /  
11. pilose <soft, long, sparse, ascending, curly or straight  
trichomes> /  
12. arachnoid <soft, very long, dense, thin, loosely  
entangled trichomes; cobwebby> /  
13. hirsute <stiff, long, dense or sparse, erect or  
ascending, straight trichomes> /  
14. hispid <stiff, long, tapered, dense or sparse, erect or  
ascending, straight trichomes; bristly> /  
15. strigose <stiff, long, sharp, bulbous base, dense or  
sparse, appressed, straight or curved trichomes> /  
16. with glandular trichomes /  
17. stellate <trichomes with branches radiating from base  
or separate hairs aggregated into star-like clusters> /  
18. with barbed trichomes /
- #822. indumentation <of corollas of ray florets; staminate  
heads; description of indumentation and location that  
serves to distinguish the taxon> /
- #823. apices <of corollas of ray florets; staminate heads;  
shape> /  
1. rounded/  
2. obtuse/  
3. acute/  
4. acuminate/
- #824. bases of corolla tubes <of ray florets of staminate heads;  
enlargement> /  
1. not enlarged in fruit <implicit> /  
2. slightly saccate in fruit <e.g., Achillea> /  
3. swollen in fruit/
- #825. stamens <of ray florets of staminate heads; presence> /  
1. present/  
2. absent/
- #826. stamens <of ray florets of staminate heads; number> /  
1. 3/  
2. 4/  
3. 5/
- #827. stamens <of ray florets of staminate heads; distinctive,  
general characters that serve to distinguish the taxon> /
- #828. stamens <of ray florets of staminate heads; length> /  
mm long/
- #829. stamens <of ray florets of staminate heads; fusion> /  
1. free/  
2. fused by filaments/  
3. fused by anthers <implicit> /
- #830. anthers <of ray florets of staminate heads; distinctive,  
general characteristics that serve to distinguish the  
taxon> /
- #831. anthers <of ray florets of staminate heads; specific color  
or colors that serves to distinguish the taxon> /
- #832. anthers <of ray florets of staminate heads; straightness> /  
1. straight/  
2. curved/
- #833. anthers <of ray florets of staminate heads; width> /  
mm wide/
- #834. anthers <of ray florets of staminate heads; length> /  
mm long/
- #835. apical appendages <of anthers of ray florets; staminate  
heads; presence> /  
1. present/  
2. absent/
- #836. apical appendages <of anthers of ray florets; staminate  
heads; appearance> /  
1. flat/  
2. keeled/  
3. curved/
- #837. apical appendages <of anthers of ray florets; staminate  
heads; shape> /  
1. linear /  
2. lanceolate/  
3. subulate/  
4. spatulate/
- #838. apical appendages <of anthers of ray florets; staminate  
heads; width> /  
mm wide/
- #839. apical appendages <of anthers of ray florets; staminate  
heads; length> /  
mm long/
- #840. thecae <of anthers of ray florets; staminate heads;  
distinctive, general characteristics that serve to distinguish  
the taxon> /
- #841. bases <of anthers of ray florets; staminate heads;  
shape> /  
1. obtuse/  
2. subtruncate/  
3. rounded/  
4. sagittate/  
5. caudate <tailed> /
- #842. connective tissue <of anthers of ray florets; staminate  
heads; distinctive, general characters that serve to  
distinguish the taxon> /
- #843. pollen <of ray florets of staminate heads; distinctive,  
general characters that serve to distinguish the taxon> /
- #844. filaments <of ray florets of staminate heads; distinctive,  
general characters that serve to distinguish the taxon> /
- #845. styles <of ray florets of staminate heads; presence> /  
1. present <implicit> /  
2. absent/

- #846. styles <of ray florets of staminate heads; distinctive, general characters that serve to distinguish the taxon>/  
1. present/  
2. absent/
- #847. styles <of ray florets of staminate heads; division>/  
1. divided/  
2. not divided/
- #848. styles <of ray florets of staminate heads; describe degree of division if serves to distinguish the taxon>/
- #849. styles <of ray florets of staminate heads; length>/  
mm long/
- #850. styles <of ray florets of staminate heads; length relative to corolla tube>/  
1. exerted beyond corolla tubes/  
2. included within corolla tubes/  
3. equalling corolla tubes/
- #851. style branches <of ray florets of staminate heads; presence>/  
1. present/  
2. absent/
- #852. style branches <of ray florets of staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #853. style branches <of ray florets of staminate heads; lobing>/  
1. not lobed/  
2. 2-lobed/
- #854. style branches <of ray florets of staminate heads; color or colors that serves to distinguish the taxon>/
- #855. style branches <of ray florets of staminate heads; shape>/  
1. linear/  
2. clavate/  
3. filiform/  
4. lanceolate/
- #856. style branches <of ray florets of staminate heads; organization of stigmatic regions>/  
1. stigmatic regions on adaxial surfaces/  
2. stigmatic regions forming 2 marginal bands/
- #857. indumentum <of style branches of ray florets; staminate heads>/  
1. glabrous/  
2. scabrous <rough to the touch with short, hard, rigid trichomes>/  
3. scaberulous <minutely scabrous>/  
4. pubescent <soft, short, dense trichomes>/  
5. puberulent <minutely pubescent>/  
6. velutinous <soft, short, dense, straight trichomes; velvety>/  
7. tomentose <soft, short, dense, matted trichomes>/  
8. villous <soft, long, dense, curly, ascending trichomes>/  
9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/  
10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/  
11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/  
12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/  
13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/  
14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/  
15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/  
16. with glandular trichomes/  
17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/  
18. with barbed trichomes/
- #858. sterile appendages <of style branches of ray florets; staminate heads; presence>/
- #859. apices <of style branches of ray florets; staminate heads; shape>/  
1. attenuate/  
2. broadly rounded/  
3. truncate/  
4. obtuse/  
5. acute/  
6. acuminate/  
7. triangular/
- #860. bases <of styles of ray florets; staminate heads; nature>/  
1. swollen/  
2. not swollen/  
3. not swollen but with shaft enlarged/
- #861. bases <of styles of ray florets; staminate heads; nectaries>/  
1. nectaries present/  
2. nectaries absent/
- #862. indumentum <of bases of styles of ray florets; staminate heads>/  
1. glabrous/  
2. scabrous <rough to the touch with short, hard, rigid trichomes>/  
3. scaberulous <minutely scabrous>/  
4. pubescent <soft, short, dense trichomes>/  
5. puberulent <minutely pubescent>/  
6. velutinous <soft, short, dense, straight trichomes; velvety>/  
7. tomentose <soft, short, dense, matted trichomes>/  
8. villous <soft, long, dense, curly, ascending trichomes>/  
9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/  
10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/  
11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/  
12. arachnoid <soft, very long, entangled trichomes; cobwebby>/  
13. hirsute <stiff, long, dense or sparse, ascending, straight trichomes>/  
14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/  
15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/  
16. with glandular trichomes/  
17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/  
18. with barbed trichomes/
- #863. sweeping hairs <on styles and style branches of ray florets; staminate heads; presence>/  
1. present/  
2. absent/
- #864. sweeping hairs <on styles and style branches of ray florets; staminate heads; arrangement>/  
1. scattered abaxially along style branches and extending down shafts of styles <e.g., Vernonia>/  
2. in ring on shafts below style branches <e.g., Cardus>/  
3. concentrated on tips of style branches/  
4. forming terminal truncate brushes on style branches <e.g., Senecio>/
- #865. sweeping hairs <on styles and style branches of ray florets; staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #866. achenes <of ray florets of staminate heads; presence>/  
1. present/  
2. absent/
- #867. achenes <of ray florets of staminate heads; distinctiveness>/  
1. vestigial <implicit>/  
2. developed/

- #868. achenes <of ray florets of staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #869. achenes <of ray florets of staminate heads; color or colors that serves to distinguish the taxon>/
- #870. achenes <of ray florets of staminate heads; surface>/
1. smooth/
  2. glandular/
  3. spiny/
  4. rugulose/
  5. setose <covered with bristles>/
  6. muricate/
  7. tuberculate/
  8. undulating/
  9. rugose/
  10. sulcate/
  11. striate/
- #871. achenes <of ray florets of staminate heads; shape in cross-section>/
1. angular/
  2. terete/
  3. trigonous/
  4. tetragonous/
  5. pentagonous/
  6. flattened/
  7. lenticular/
- #872. achenes <of ray florets of staminate heads; shape in longitudinal-section>/
1. columnar/
  2. conical/
  3. fusiform/
  4. ovate/
  5. oblong/
  6. obconical/
  7. elliptic/
  8. obovate/
  9. oblanceolate/
  10. lanceolate/
  11. linear/
  12. clavate/
  13. cylindrical/
- #873. achenes <of ray florets of staminate heads; width>/
- mm wide/
- #874. achenes <of ray florets of staminate heads; length>/
- mm long/
- #875. indumentum <of achenes of ray florets; staminate heads>/
1. glabrous/
  2. scabrous <rough to the touch with short, hard, rigid trichomes>/
  3. scaberulous <minutely scabrous>/
  4. pubescent <soft, short, dense trichomes>/
  5. puberulent <minutely pubescent>/
  6. velutinous <soft, short, dense, straight trichomes; velvety>/
  7. tomentose <soft, short, dense, matted trichomes>/
  8. villous <soft, long, dense, curly, ascending trichomes>/
  9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/
  10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/
  11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/
  12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/
  13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/
  14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/
  15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/
  16. with glandular trichomes/
  17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/
18. with barbed trichomes/
- #876. indumentum <of achenes of ray florets; staminate heads; location; descriptors for location of hairs that serve to characterize the taxon>/
- #877. ribs <of achenes of ray florets; staminate heads; presence>/
1. present/
  2. absent/
- #878. ribs <of achenes of ray florets; staminate heads; number>/
1. 1/
  2. 2/
  3. 3/
  4. 4/
  5. 5/
  6. 6/
  7. 7/
  8. 8/
  9. 9/
  10. 10/
  11. 12 or more/
- #879. ribs <of achenes of ray florets; staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #880. ribs <of achenes of ray florets; staminate heads; conspicuousness>/
1. conspicuous/
  2. inconspicuous/
- #881. wings <of achenes of ray florets; staminate heads; presence>/
1. present/
  2. absent/
- #882. wings <of achenes of ray florets; staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #883. wings <of achenes of ray florets; staminate heads; position>/
1. continuous from apices to bases/
  2. primarily apical/
  3. primarily basal/
- #884. beaks <of achenes of ray florets; staminate heads; presence>/
1. present/
  2. absent/
- #885. beaks <of achenes of ray florets; staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #886. beaks <of achenes of ray florets; staminate heads; curvature>/
1. curved/
  2. not curved/
- #887. beaks <of achenes of ray florets; staminate heads; specific color or colors that serves to distinguish the taxon>/
- #888. beaks <of achenes of ray florets; staminate heads; length>/
- mm long/
- #889. bases <of achenes of ray florets; staminate heads; attachment>/
1. attached to subtending receptacular bracts/
  2. not attached to subtending receptacular bracts/
- #890. disk florets <of staminate heads; presence>/
1. present/
  2. absent/
- #891. disk florets <of staminate heads; number>/
1. 2/

2. 3/
  3. 4/
  4. 5/
  5. 6/
  6. 7/
  7. 8/
  8. 9/
  9. 10-20/
  10. 20 or more/
- #892. disk florets <of staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #893. disk florets <of staminate heads; sexuality>  
<MANDATORY>/
1. perfect/
  2. pistillate/
  3. staminate/
  4. neuter/
  5. perfect, but functionally pistillate/
  6. perfect, but functionally staminate/
- #894. disk florets <of staminate heads; fertility; producing achenes>/
1. fertile/
  2. sterile/
- #895. pappus <of disk florets of staminate heads; presence>/
1. absent/
  2. present; in 1 whorl/
  3. present; in 2 whorls <double>/
- #896. pappus <of disk florets when in 1 whorl; staminate heads; morphological forms>/
1. of awns/
  2. of scales/
  3. of teeth/
  4. of appressed teeth/
  5. of capillary hairs/
  6. of capillary bristles/
  7. of bristles/
  8. of scabrous bristles/
  9. of stiff bristles/
  10. of plumose bristles/
  11. coroniform/
  12. of barbellate bristles/
  13. of scarios scales/
  14. of smooth bristles/
  15. of hairs/
  16. an adaxial auricle <e.g., Anthemis>/
  17. of bristlelike scales/
  18. of stiff scales/
  19. of subclavate hairs/
  20. of subulate hairs <awl-shaped>/
  21. a crenulate rim <e.g., Heliopsis>/
  22. of barbellate awns/
  23. of retrorsely hispid awns/
  24. of fimbriate awns/
  25. of elongate awns/
  26. of serrulate awns/
- #897. pappus <of disk florets when in 1 whorl; staminate heads; number of parts>/
1. 1/
  2. 2/
  3. 3/
  4. 4/
  5. 5/
  6. 6/
  7. 7/
  8. 8/
  9. 9/
  10. 10/
  11. 11/
  12. 12 or more/
  13. numerous <number, if countable>/
- #898. pappus <of disk florets when in 1 whorl; staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #899. pappus <of disk florets when in 1 whorl; staminate heads; persistence>/
1. caducous/
  2. persistent in fruit/
  3. not persistent in fruit/
- #900. pappus <of disk florets when in 1 whorl; staminate heads; fusion>/
1. free/
  2. fused/
  3. fused at bases/
- #901. pappus <of disk florets when in 1 whorl; staminate heads; aspect>/
1. appressed/
  2. ascending/
  3. spreading/
  4. reflexed/
  5. curled/
- #902. pappus <of disk florets when in 1 whorl; staminate heads; specific color or colors that serves to distinguish the taxon>/
- #903. pappus <of disk florets when in 1 whorl; staminate heads; nature>/
1. fragile/
  2. stout/
- #904. pappus <of disk florets when in 1 whorl; staminate heads; nature>/
1. slender/
  2. thick/
  3. flattened on outer sides <e.g., Brickellia>/
- #905. pappus <of disk florets when in 1 whorl; staminate heads; width>/
- mm wide/
- #906. pappus <of disk florets when in 1 whorl; staminate heads; equality in length>/
1. all equal in length/
  2. unequal in length/
- #907. pappus <of disk florets when in 1 whorl; staminate heads; length>/
- mm long/
- #908. indumentum <of pappus of disk florets when in 1 whorl; staminate heads>/
1. glabrous/
  2. scabrous <rough to the touch with short, hard, rigid trichomes>/
  3. scaberulous <minutely scabrous>/
  4. pubescent <soft, short, dense trichomes>/
  5. puberulent <minutely pubescent>/
  6. velutinous <soft, short, dense, straight trichomes; velvety>/
  7. tomentose <soft, short, dense, matted trichomes>/
  8. villous <soft, long, dense, curly, ascending trichomes>/
  9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/
  10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/
  11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/
  12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/
  13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/
  14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/
  15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/
  16. with glandular trichomes/
  17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/
  18. with barbed trichomes/
- #909. apices <of pappus of disk florets when in 1 whorl; staminate heads; shape>/

1. rounded/
  2. obtuse/
  3. acute/
  4. acuminate/
- #910. apices <of pappus of disk florets when in 1 whorl; staminate heads>/
1. with midribs excurrent as awns/
  2. with midribs not excurrent as awns/
- #911. margins <of pappus of disk florets when in 1 whorl; staminate heads>/
1. entire/
  2. undulate/
  3. sinuate/
  4. crenate/
  5. crenulate/
  6. erose/
  7. serrate/
  8. doubly serrate/
  9. serrulate/
  10. dentate/
  11. denticulate/
  12. incised/
  13. lacerate/
  14. lacinate/
  15. crispate/
  16. ciliate/
  17. spinose/
  18. scarious/
  19. membranous/
- #912. bases <of pappus of disk florets when in 1 whorl; staminate heads; nature>/
1. wide/
  2. narrow/
- #913. bases <of pappus of disk florets when in 1 whorl; staminate heads; nature>/
1. thick/
  2. thin/
- #914. bases <of pappus of disk florets when in 1 whorl; staminate heads; nature>/
1. straight/
  2. curved/
- #915. outer pappus <of disk florets when in 2 whorls; staminate heads; morphological forms>/
1. of awns/
  2. of scales/
  3. of teeth/
  4. of appressed teeth/
  5. of capillary hairs/
  6. of capillary bristles/
  7. of bristles/
  8. of scabrous bristles/
  9. of stiff bristles/
  10. of plumose bristles/
  11. coroniform/
  12. of barbellate bristles/
  13. of scarious scales/
  14. of smooth bristles/
  15. of hairs/
  16. an adaxial auricle <e.g., Anthemis>/
  17. of bristlelike scales/
  18. of stiff scales/
  19. of subclavate hairs/
  20. of subulate hairs <awl-shaped>/
  21. a crenulate rim <e.g., Heliopsis>/
  22. of barbellate awns/
  23. of retrorsely hispid awns/
  24. of fimbriate awns/
  25. of elongate awns/
  26. of serrulate awns/
- #916. outer pappus <of disk florets when in 2 whorls; staminate heads; number of parts>/
1. 1/
  2. 2/
  3. 3/
  4. 4/
  5. 5/
  6. 6/
  7. 7/
  8. 8/
  9. 9/
  10. 10/
  11. 11/
  12. 12 or more/
  13. numerous <number, if countable>/
- #917. outer pappus <of disk florets when in 2 whorls; staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #918. outer pappus <of disk florets when in 2 whorls; staminate heads; persistence>/
1. caducous/
  2. persistent in fruit/
  3. not persistent in fruit/
- #919. outer pappus <of disk florets when in 2 whorls; staminate heads; fusion>/
1. free/
  2. fused/
  3. fused at bases/
- #920. outer pappus <of disk florets when in 2 whorls; staminate heads; aspect>/
1. appressed/
  2. ascending/
  3. spreading/
  4. reflexed/
  5. curled/
- #921. outer pappus <of disk florets when in 2 whorls; staminate heads; specific color or colors that serves to distinguish the taxon>/
- #922. outer pappus <of disk florets when in 2 whorls; staminate heads; nature>/
1. fragile/
  2. stout/
- #923. outer pappus <of disk florets when in 2 whorls; staminate heads; nature>/
1. slender/
  2. thick/
  3. flattened on outer sides <e.g., Brickellia>/
- #924. outer pappus <of disk florets when in 2 whorls; staminate heads; width>/
- mm wide/
- #925. outer pappus <of disk florets when in 2 whorls; staminate heads; equality in length>/
1. all equal in length/
  2. unequal in length/
- #926. outer pappus <of disk florets when in 2 whorls; staminate heads; length>/
- mm long/
- #927. indumentum <of outer pappus of disk florets when in 2 whorls; staminate heads>/
1. glabrous/
  2. scabrous <rough to the touch with short, hard, rigid trichomes>/
  3. scaberulous <minutely scabrous>/
  4. pubescent <soft, short, dense trichomes>/
  5. puberulent <minutely pubescent>/
  6. velutinous <soft, short, dense, straight trichomes; velvety>/
  7. tomentose <soft, short, dense, matted trichomes>/
  8. villous <soft, long, dense, curly, ascending trichomes>/
  9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/
  10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/
  11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/

12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/
  13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/
  14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/
  15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/
  16. with glandular trichomes/
  17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/
  18. with barbed trichomes/
- #928. apices <of outer pappus of disk florets of staminate heads when in 2 whorls; shape>/
1. rounded/
  2. obtuse/
  3. acute/
  4. acuminate/
- #929. apices <of outer pappus of disk florets of staminate heads when in 2 whorls>/
1. with midribs excurrent as awns/
  2. midribs not excurrent as awns/
- #930. margins <of outer pappus of disk florets when in 2 whorls; staminate heads>/
1. entire/
  2. undulate/
  3. sinuate/
  4. crenate/
  5. crenulate/
  6. erose/
  7. serrate/
  8. doubly serrate/
  9. serrulate/
  10. dentate/
  11. denticulate/
  12. incised/
  13. lacerate/
  14. lacinate/
  15. crispate/
  16. ciliate/
  17. spinose/
  18. scarious/
  19. membranous/
- #931. bases <of outer pappus of disk florets when in 2 whorls; staminate heads; nature>/
1. wide/
  2. narrow/
- #932. bases <of outer pappus of disk florets when in 2 whorls; staminate heads; nature>/
1. thick/
  2. thin/
- #933. bases <of outer pappus of disk florets when in 2 whorls; staminate heads; nature>/
1. straight/
  2. curved/
- #934. inner pappus <of disk florets when in 2 whorls; staminate heads; morphological forms>/
1. of awns/
  2. of scales/
  3. of teeth/
  4. of appressed teeth/
  5. of capillary hairs/
  6. of capillary bristles/
  7. of bristles/
  8. of scabrous bristles/
  9. of stiff bristles/
  10. of plumose bristles/
  11. coroniform/
  12. of barbellate bristles/
  13. of scarious scales/
  14. of smooth bristles/
  15. of hairs/
  16. an adaxial auricle <e.g., Anthemis>/
  17. of bristlelike scales/
18. of stiff scales/
  19. of subclavate hairs/
  20. of subulate hairs <awl-shaped>/
  21. a crenulate rim <e.g., Heliopsis>/
  22. of barbellate awns/
  23. of retrorsely hispid awns/
  24. of fimbriate awns/
  25. of elongate awns/
  26. of serrulate awns/
- #935. inner pappus <of disk florets when in 2 whorls; staminate heads; number of parts>/
1. 1/
  2. 2/
  3. 3/
  4. 4/
  5. 5/
  6. 6/
  7. 7/
  8. 8/
  9. 9/
  10. 10/
  11. 11/
  12. 12 or more/
  13. numerous <number, if countable>/
- #936. inner pappus <of disk florets when in 2 whorls; staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #937. inner pappus <of disk florets when in 2 whorls; staminate heads; persistence>/
1. caducous/
  2. persistent in fruit/
  3. not persistent in fruit/
- #938. inner pappus <of disk florets when in 2 whorls; staminate heads; fusion>/
1. free/
  2. fused/
  3. fused at bases/
- #939. inner pappus <of disk florets when in 2 whorls; staminate heads; aspect>/
1. appressed/
  2. ascending/
  3. spreading/
  4. reflexed/
  5. curled/
- #940. inner pappus <of disk florets when in 2 whorls; staminate heads; specific color or colors that serves to distinguish the taxon>/
- #941. inner pappus <of disk florets when in 2 whorls; staminate heads; nature>/
1. fragile/
  2. stout/
- #942. inner pappus <of disk florets when in 2 whorls; staminate heads; nature>/
1. slender/
  2. thick/
  3. flattened on outer sides <e.g., Brickellia>/
- #943. inner pappus <of disk florets when in 2 whorls; staminate heads; width>/
- mm wide/
- #944. inner pappus <of disk florets when in 2 whorls; staminate heads; equality in length>/
1. all equal in length/
  2. unequal in length/
- #945. inner pappus <of disk florets when in 2 whorls; staminate heads; length>/
- mm long/
- #946. indumentum <of inner pappus of disk florets when in 2 whorls; staminate heads>/
1. glabrous/

2. scabrous <rough to the touch with short, hard, rigid trichomes>/
  3. scaberulous <minutely scabrous>/
  4. pubescent <soft, short, dense trichomes>/
  5. puberulent <minutely pubescent>/
  6. velutinous <soft, short, dense, straight trichomes; velvety>/
  7. tomentose <soft, short, dense, matted trichomes>/
  8. villous <soft, long, dense, curly, ascending trichomes>/
  9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/
  10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/
  11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/
  12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/
  13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/
  14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/
  15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/
  16. with glandular trichomes/
  17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/
  18. with barbed trichomes/
- #947. apices <of inner pappus of disk florets when in 2 whorls; staminate heads; shape>/
1. rounded/
  2. obtuse/
  3. acute/
  4. acuminate/
- #948. apices <of inner pappus of disk florets when in 2 whorls; staminate heads>/
1. with midribs excurrent as awns/
  2. with midribs not excurrent as awns/
- #949. margins <of inner pappus of disk florets when in 2 whorls; staminate heads>/
1. entire/
  2. undulate/
  3. sinuate/
  4. crenate/
  5. crenulate/
  6. erose/
  7. serrate/
  8. doubly serrate/
  9. serrulate/
  10. dentate/
  11. denticulate/
  12. incised/
  13. lacerate/
  14. lacinate/
  15. crispate/
  16. ciliate/
  17. spinose/
  18. scarious/
  19. membranous/
- #950. bases <of inner pappus of disk florets when in 2 whorls; staminate heads; nature>/
1. wide/
  2. narrow/
- #951. bases <of inner pappus of disk florets when in 2 whorls; staminate heads; nature>/
1. thick/
  2. thin/
- #952. bases <of inner pappus of disk florets when in 2 whorls; staminate heads; nature>/
1. straight/
  2. curved/
- #953. corollas <of disk florets of staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #954. corollas <of disk florets of staminate heads; fusion of lobes>/
1. 4-lobed/
  2. 5-lobed/
  3. shallowly 5-lobed/
  4. deeply 5-lobed/
- #955. corollas <of disk florets of staminate heads; persistence>/
1. cauducous/
  2. persistent at maturity/
  3. deciduous at maturity/
- #956. corollas <of disk florets of staminate heads; specific color or colors that serves to distinguish the taxon>/
- #957. corollas <of disk florets of staminate heads; texture>/
1. membranous/
  2. fleshy/
  3. succulent/
  4. cartilaginous <hard and tough, but flexible>/
  5. chartaceous <papery, opaque and thin, e.g., Hymenoxys>/
  6. coriaceous <leathery>/
  7. flaccid <lax and weak>/
  8. herbaceous <soft and succulent>/
  9. hyaline <thin and translucent or transparent>/
  10. indurate <hardened>/
  11. scarious <thin and dry>/
- #958. corollas <of disk florets of staminate heads; shape>/
1. campanulate/
  2. salverform/
  3. funnelform/
  4. tubular/
  5. urceolate/
- #959. corollas <of disk florets of staminate heads; width>/
- mm wide/
- #960. corollas <of disk florets of staminate heads; length>/
- mm long/
- #961. indumentum <of corollas of disk florets; staminate heads>/
1. glabrous/
  2. scabrous <rough to the touch with short, hard, rigid trichomes>/
  3. scaberulous <minutely scabrous>/
  4. pubescent <soft, short, dense trichomes>/
  5. puberulent <minutely pubescent>/
  6. velutinous <soft, short, dense, straight trichomes; velvety>/
  7. tomentose <soft, short, dense, matted trichomes>/
  8. villous <soft, long, dense, curly, ascending trichomes>/
  9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/
  10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/
  11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/
  12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/
  13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/
  14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/
  15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/
  16. with glandular trichomes/
  17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/
  18. with barbed trichomes/
- #962. indumentation <of corollas of disk florets; staminate heads; description of indumentation and location that serves to distinguish the taxon>/
- #963. lobes <of corollas of disk florets; staminate heads; aspect>/
1. erect/
  2. ascending/



3. spreading/
  4. reflexed/
  5. curled/
- #964. apices <of corolla lobes of disk florets; staminate heads; shape>/
1. rounded/
  2. obtuse/
  3. acute/
  4. acuminate/
- #965. bases of corolla tubes <of disk florets; staminate heads; enlargement>/
1. not enlarged in fruit <implicit>/
  2. slightly saccate in fruit <e.g., Achillea>/
  3. swollen in fruit/
- #966. stamens <of disk florets of staminate heads; presence>/
1. present <implicit>/
  2. absent/
- #967. stamens <of disk florets of staminate heads; number>/
1. 3/
  2. 4/
  3. 5/
- #968. stamens <of disk florets of staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #969. stamens <of disk florets of staminate heads; length>/
- mm long/
- #970. stamens <of disk florets of staminate heads; fusion>/
1. free/
  2. fused by filaments/
  3. fused by anthers <implicit>/
- #971. anthers <of disk florets of staminate heads; distinctive, general characteristics that serve to distinguish the taxon>/
- #972. anthers <of disk florets of staminate heads; specific color or colors that serves to distinguish the taxon>/
- #973. anthers <of disk florets of staminate heads; straightness>/
1. straight/
  2. curved/
- #974. anthers <of disk florets of staminate heads; width>/
- mm wide/
- #975. anthers <of disk florets of staminate heads; length>/
- mm long/
- #976. apical appendages <of anthers of disk florets; staminate heads; presence>/
1. present/
  2. absent/
- #977. apical appendages <of anthers of disk florets; staminate heads; appearance>/
1. flat/
  2. keeled/
  3. curved/
- #978. apical appendages <of anthers of disk florets; staminate heads; shape>/
1. linear/
  2. lanceolate/
  3. subulate/
  4. spatulate/
- #979. apical appendages <of anthers of disk florets; staminate heads; width>/
- mm wide/
- #980. apical appendages <of anthers of disk florets; staminate heads; length>/
- mm long/
- #981. thecae <of anthers of disk florets; staminate heads; distinctive, general characteristics that serve to distinguish the taxon>/
- #982. bases <of anthers of disk florets; staminate heads; shape>/
1. obtuse/
  2. subtruncate/
  3. rounded/
  4. sagittate/
  5. caudate <tailed>/
- #983. connective tissue <of anthers of disk florets; staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #984. pollen <of disk florets of staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #985. filaments <of disk florets of staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #986. styles <of disk florets of staminate heads; presence>/
1. present <implicit>/
  2. absent/
- #987. styles <of disk florets of staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #988. styles <of disk florets of staminate heads; division>/
1. divided/
  2. not divided/
- #989. styles <of disk florets of staminate heads; describe degree of division if serves to distinguish the taxon>/
- #990. styles <of disk florets of staminate heads; length>/
- mm long/
- #991. styles <of disk florets of staminate heads; length relative to corollas tube>/
1. exerted beyond corolla tubes/
  2. included within corolla tubes/
  3. equalling corolla tubes/
- #992. style branches <of disk florets of staminate heads; presence>/
1. present/
  2. absent/
- #993. style branches <of disk florets of staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #994. style branches <of disk florets of staminate heads; lobing>/
1. not lobed/
  2. 2-lobed/
- #995. style branches <of disk florets of staminate heads; color or colors that serves to distinguish the taxon>/
- #996. style branches <of disk florets of staminate heads; shape>/
1. linear/
  2. clavate/
  3. filiform/
  4. lanceolate/
- #997. style branches <of disk florets of staminate heads; organization of stigmatic regions>/
1. stigmatic regions on adaxial surfaces/
  2. stigmatic regions forming 2 marginal bands/
- #998. indumentum <of style branches of disk florets; staminate heads>/
1. glabrous/
  2. scabrous <rough to the touch with short, hard, rigid trichomes>/
  3. scaberulous <minutely scabrous>/
  4. pubescent <soft, short, dense trichomes>/

5. puberulent <minutely pubescent>/
  6. velutinous <soft, short, dense, straight trichomes; velvety>/
  7. tomentose <soft, short, dense, matted trichomes>/
  8. villous <soft, long, dense, curly, ascending trichomes>/
  9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/
  10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/
  11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/
  12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/
  13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/
  14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/
  15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/
  16. with glandular trichomes/
  17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/
  18. with barbed trichomes/
- #999. sterile appendages <of style branches of disk florets; staminate heads; presence>/
1. present/
  2. absent/
- #1000. apices <of style branches of disk florets; staminate heads; shape>/
1. attenuate/
  2. broadly rounded/
  3. truncate/
  4. obtuse/
  5. acute/
  6. acuminate/
  7. triangular/
- #1001. bases <of styles of disk florets; staminate heads; nature>/
1. swollen/
  2. not swollen/
  3. not swollen but with shaft enlarged/
- #1002. bases <of styles of disk florets; staminate heads; nectaries>/
1. nectaries present/
  2. nectaries absent/
- #1003. indumentum <of bases of styles of disk florets; staminate heads>/
1. glabrous/
  2. scabrous <rough to the touch with short, hard, rigid trichomes>/
  3. scaberulous <minutely scabrous>/
  4. pubescent <soft, short, dense trichomes>/
  5. puberulent <minutely pubescent>/
  6. velutinous <soft, short, dense, straight trichomes; velvety>/
  7. tomentose <soft, short, dense, matted trichomes>/
  8. villous <soft, long, dense, curly, ascending trichomes>/
  9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/
  10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/
  11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/
  12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/
  13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/
  14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/
  15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/
  16. with glandular trichomes/
  17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/
  18. with barbed trichomes/
- #1004. sweeping hairs <on styles and style branches of disk florets; staminate heads; presence>/
1. present/
  2. absent/
- #1005. sweeping hairs <on styles and style branches of disk florets; staminate heads; arrangement>/
1. scattered abaxially along style branches and extending down shafts of styles <e.g., Vernonia>/
  2. in ring on shafts below style branches <e.g., Cardus>/
  3. concentrated on tips of style branches/
  4. forming terminal truncate brushes on style branches <e.g., Senecio>/
- #1006. sweeping hairs <on styles and style branches of disk florets; staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1007. achenes <of disk florets of staminate heads; presence>/
1. present/
  2. absent/
- #1008. achenes <of disk florets of staminate heads; distinctiveness>/
1. vestigial/
  2. developed/
- #1009. achenes <of disk florets of staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1010. achenes <of disk florets of staminate heads; color or colors that serves to distinguish the taxon>/
- #1011. achenes <of disk florets of staminate heads; surface>/
1. smooth/
  2. glandular/
  3. spiny/
  4. rugulose/
  5. setose <covered with bristles>/
  6. muricate/
  7. tuberculate/
  8. undulating/
  9. rugose/
  10. sulcate/
  11. striate/
- #1012. achenes <of disk florets of staminate heads; shape in cross-section>/
1. angular/
  2. terete/
  3. trigonous/
  4. tetragonous/
  5. pentagonous/
  6. flattened/
  7. lenticular/
- #1013. achenes <of disk florets of staminate heads; shape in longitudinal-section>/
1. columnar/
  2. conical/
  3. fusiform/
  4. ovate/
  5. oblong/
  6. obconical/
  7. elliptic/
  8. obovate/
  9. oblanceolate/
  10. lanceolate/
  11. linear/
  12. clavate/
  13. cylindrical/
- #1014. achenes <of disk florets of staminate heads; width>/
- mm wide/
- #1015. achenes <of disk florets of staminate heads; length>/
- mm long/
- #1016. indumentum <of achenes of disk florets; staminate heads>/
1. glabrous/

2. scabrous <rough to the touch with short, hard, rigid trichomes>/
  3. scaberulous <minutely scabrous>/
  4. pubescent <soft, short, dense trichomes>/
  5. puberulent <minutely pubescent>/
  6. velutinous <soft, short, dense, straight trichomes; velvety>/
  7. tomentose <soft, short, dense, matted trichomes>/
  8. villous <soft, long, dense, curly, ascending trichomes>/
  9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/
  10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/
  11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/
  12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/
  13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/
  14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/
  15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/
  16. with glandular trichomes/
  17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/
  18. with barbed trichomes/
- #1017. indumentum <of achenes of disk florets; staminate heads; location; descriptors for location of hairs that serve to characterize the taxon>/
- #1018. ribs <of achenes of disk florets; staminate heads; presence>/
1. present/
  2. absent/
- #1019. ribs <of achenes of disk florets; staminate heads; number>/
1. 1/
  2. 2/
  3. 3/
  4. 4/
  5. 5/
  6. 6/
  7. 7/
  8. 8/
  9. 9/
  10. 10/
  11. 12 or more/
- #1020. ribs <of achenes of disk florets; staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1021. ribs <of achenes of disk florets; staminate heads; conspicuousness>/
1. conspicuous/
  2. inconspicuous/
- #1022. wings <of achenes of disk florets; staminate heads; presence>/
1. present/
  2. absent/
- #1023. wings <of achenes of disk florets; staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1024. wings <of achenes of disk florets; staminate heads; position>/
1. continuous from apices to bases/
  2. primarily apical/
  3. primarily basal/
- #1025. beaks <of achenes of disk florets; staminate heads; presence>/
1. present/
  2. absent/
- #1026. beaks <of achenes of disk florets; staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1027. beaks <of achenes of disk florets; staminate heads; curvature>/
1. curved/
  2. not curved/
- #1028. beaks <of achenes of disk florets; staminate heads; specific color or colors that serves to distinguish the taxon>/
- #1029. beaks <of achenes of disk florets; staminate heads; length>/
- mm long/
- #1030. bases <of achenes of disk florets; staminate heads; attachment>/
1. attached to subtending receptacular bracts/
  2. not attached to subtending receptacular bracts/
- #1031. receptacles <of staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1032. receptacles <of staminate heads; shape>/
1. flat/
  2. cylindrical/
  3. concave/
  4. convex/
  5. conical/
  6. globose/
  7. elongate/
  8. subulate/
  9. hemispheric/
  10. subglobose/
- #1033. receptacles <of staminate heads; density>/
1. solid/
  2. spongy/
  3. hollow <e.g., Heliopsis>/
- #1034. surfaces <of receptacles of staminate heads; appearance>/
1. smooth/
  2. pitted <or alveolate>/
- #1035. surfaces <of receptacle of staminate heads; indumentum>/
1. glabrous/
  2. indumented <describe if distinctive>/
  3. setose <bristly>/
- #1036. receptacular bracts <of staminate heads; presence>/
1. present/
  2. absent/
- #1037. receptacular bracts <of staminate heads; persistence>/
1. persistent/
  2. deciduous/
- #1038. receptacular bracts <of staminate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1039. receptacular bracts <of staminate heads; color or colors that serves to distinguish the taxon>/
- #1040. receptacular bracts <of staminate heads; shape>/
1. linear/
  2. lanceolate/
  3. oblanceolate/
  4. elliptic/
  5. ovate/
  6. obovate/
  7. oblong/
- #1041. receptacular bracts <of staminate heads; appearance>/
1. angular/
  2. rounded/
  3. flat/

- #1042. receptacular bracts <of staminate heads; nature>/  
1. straight/  
2. curved/
- #1043. receptacular bracts <of staminate heads; keels>/  
1. keeled/  
2. not keeled/
- #1044. receptacular bracts <of staminate heads; width>/  
mm wide/
- #1045. receptacular bracts <of staminate heads; length>/  
1. longer than disk florets <e.g., Silphium, Echinacea>/  
2. shorter than disk florets/
- #1046. receptacular bracts <of staminate heads; length>/  
mm long/
- #1047. indumentum <of staminate heads; of receptacular bracts>/  
1. glabrous/  
2. scabrous <rough to the touch with short, hard, rigid trichomes>/  
3. scaberulous <minutely scabrous>/  
4. pubescent <soft, short, dense trichomes>/  
5. puberulent <minutely pubescent>/  
6. velutinous <soft, short, dense, straight trichomes; velvety>/  
7. tomentose <soft, short, dense, matted trichomes>/  
8. villous <soft, long, dense, curly, ascending trichomes>/  
9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/  
10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/  
11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/  
12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/  
13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/  
14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/  
15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/  
16. with glandular trichomes/  
17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/  
18. with barbed trichomes/
- #1048. apices <of receptacular bracts of staminate heads; shape>/  
1. truncate/  
2. acute/  
3. acuminate/  
4. rounded/  
5. obtuse/
- #1049. apices <of receptacular bracts of staminate heads>/  
1. with midribs excurrent as awns/  
2. with midribs not excurrent as awns/
- #1050. margins <of receptacular bracts of staminate heads>/  
1. entire/  
2. undulate/  
3. sinuate/  
4. crenate/  
5. crenulate/  
6. erose/  
7. serrate/  
8. doubly serrate/  
9. serrulate/  
10. dentate/  
11. denticulate/  
12. incised/  
13. lacerate/  
14. lacinate/  
15. crispate/  
16. ciliate/  
17. spinose/  
18. scarious/
19. membranous/
- #1051. bases <of receptacular bracts of staminate heads; nature>/  
1. wide/  
2. narrow/
- #1052. bases <of receptacular bracts of staminate heads; nature>/  
1. thick/  
2. thin/
- #1053. bases <of receptacular bracts of staminate heads; nature>/  
1. straight/  
2. curved/
- #1054. pistillate heads <number; if several to numerous, give range of numbers> <MANDATORY>/
- #1055. pistillate heads <distinctive, general characters that serve to distinguish the taxon>/
- #1056. pistillate heads <arrangement; add descriptors as necessary> <MANDATORY>/  
1. solitary/  
2. in pairs/  
3. in cymes/  
4. in scorpioid cymes/  
5. in spikes/  
6. in racemes/  
7. in rounded panicles/  
8. in pyramidal panicles/  
9. in corymbs <flat-topped>/  
10. in glomerules/  
11. in fascicles/  
12. in clusters/
- #1057. pistillate heads <position on plant>/  
1. terminal/  
2. axillary/
- #1058. pistillate heads <aspect relative to peduncle>/  
1. held erect <e.g., Solidago rigida>/  
2. held horizontally <e.g., Silphium laciniatum>/  
3. held obliquely <e.g., Liatris>/  
4. pendulous <e.g., Ambrosia>/
- #1059. pistillate heads <secondary involucre>/  
1. surrounded by secondary involucres <e.g., Elephantopus>/  
2. not surrounded by secondary involucres <implicit>/
- #1060. pistillate heads <flore arrangement> <MANDATORY>/  
1. with ray florets only/  
2. with disk florets only/  
3. with both ray and disk florets/  
4. with ligulate florets only <Lactuceae>/
- #1061. pistillate heads <width>/  
mm wide/
- #1062. pistillate heads <length>/  
mm long/
- #1063. primary peduncles <of pistillate heads; axis terminating in a compound inflorescence of heads or when heads solitary; presence>/  
1. present <implicit>/  
2. absent/
- #1064. primary peduncles <of pistillate heads; axis terminating in a compound inflorescence of heads or when heads solitary; distinctive general characters that serve to distinguish the taxon>/
- #1065. primary peduncles <of pistillate heads; axis terminating in a compound inflorescence of heads or when heads solitary; length>/

- cm long/
- #1066. secondary peduncles <of pistillate heads; axis terminating in a single head; presence>/  
1. present/  
2. absent/
- #1067. secondary peduncles <of pistillate heads; axis terminating in a single head; distinctive general characters that serve to distinguish the taxon>/
- #1068. secondary peduncles <of pistillate heads; axis terminating in a single head; length>/  
mm long/
- #1069. phyllaries <of pistillate heads; presence>/  
1. present <implicit>/  
2. absent <e.g., Psilocarphus>/
- #1070. phyllaries <of pistillate heads; morphological forms>  
<MANDATORY>/  
1. all alike/  
2. of 2 forms/  
3. of 3 forms/  
4. of 4 or more forms/
- #1071. phyllaries <when all alike; pistillate heads; number>/  
1. 1/  
2. 2/  
3. 3/  
4. 4/  
5. 5/  
6. 6/  
7. 7/  
8. 8/  
9. 9/  
10. 10/  
11. 12 -20/  
12. 20-30/  
13. 30 or more/
- #1072. phyllaries <when all alike; pistillate heads; rows>/  
1. in 1 row/  
2. in 2 rows/  
3. in 3 rows <e.g., Zinnia>/  
4. in 4 rows <e.g., Rudbeckia>/  
5. in 5 rows/  
6. in 6 rows/  
7. in 7 or more rows <e.g., Aster patens>/
- #1073. phyllaries <when all alike in 1 row; pistillate heads; descriptive, general characters that serve to distinguish the taxon>/
- #1074. phyllaries <when all alike in 1 row; pistillate heads; persistence>/  
1. caducous/  
2. deciduous/  
3. persistent <implicit>/
- #1075. phyllaries <when all alike in 1 row; pistillate heads; imbricate>/  
1. imbricate/  
2. not imbricate/
- #1076. phyllaries <when all alike in 1 row; pistillate heads; fusion>/  
1. free/  
2. fused/  
3. fused at bases/  
4. fused, forming a bur/  
5. fused, forming a spiny bur/
- #1077. phyllaries <when all alike in 1 row; pistillate heads; aspect>/  
1. appressed/  
2. ascending/  
3. spreading/  
4. reflexed/  
5. curled/
6. deflexed/
- #1078. phyllaries <when all alike in 1 row; pistillate heads; specific color or colors that serves to distinguish the taxon>/
- #1079. phyllaries <when all alike in 1 row; pistillate heads; texture>/  
1. fleshy/  
2. succulent/  
3. cartilaginous <hard and tough, but flexible>/  
4. chartaceous <papery, opaque and thin>/  
5. coriaceous <leathery>/  
6. fibrous <having loose, woody strands>/  
7. flaccid <lax and weak>/  
8. herbaceous <soft and succulent>/  
9. hyaline <thin and translucent or transparent>/  
10. indurate <hardened>/  
11. membranous <thin and semi-transparent>/  
12. scarious <thin and dry>/  
13. spongy <cellular, sponge-like>/  
14. subherbaceous/  
15. foliaceous <leaf-like>/
- #1080. phyllaries <when all alike in 1 row; pistillate heads; shape>/  
1. subulate/  
2. acicular/  
3. filiform/  
4. linear/  
5. lanceolate/  
6. oblanceolate/  
7. ovate/  
8. obovate/  
9. elliptic/  
10. oblong/  
11. spathulate/  
12. runcinate/  
13. pandurate/  
14. deltoid/  
15. obdeltoid/  
16. cordate/  
17. obcordate/  
18. reniform/  
19. sagittate/  
20. flabellate/  
21. orbicular/  
22. oval/  
23. ensiform/  
24. squarrose/  
25. concave/
- #1081. phyllaries <when all alike in 1 row; pistillate heads; width>/  
mm wide/
- #1082. phyllaries <when all alike in 1 row; pistillate heads; length>/  
mm long/
- #1083. phyllaries <when all alike in 1 row; pistillate heads; surface>/  
1. smooth/  
2. glaucous <waxy covering>/  
3. echinate <stout prickles>/  
4. farinaceous <mealy covering>/  
5. glandular <covered with secretory structures>/  
6. muricate <short, hard protuberances, bumpy>/  
7. resinous <yellowish, sticky exudate>/  
8. scabrous <roughened by short, pointed projections>/  
9. scurfy <mealy; small bran-like scales>/  
10. tuberculate <warty, small swellings>/  
11. punctate <dented; pitted; minute impressions or depressions>/  
12. pulverulent <dusty or powdery>/  
13. rugose <wrinkled or venation impressed in the surface>/  
14. sulcate <longitudinal grooves>/  
15. winged <flat extension>/  
16. alveolate <pitted surface with pits separated by thin partitions; honey-combed>/

17. ridged/
  18. ribbed/
  19. pustulate <minute blisters>/
  20. striate <longitudinal blisters>/
- #1084. venation <of phyllaries when all alike in 1 row; pistillate heads; conspicuousness>/
1. not apparent/
  2. inconspicuous/
  3. conspicuous/
- #1085. venation <of phyllaries when all alike in 1 row; pistillate heads; number>/
1. of 1 vein/
  2. of 2 veins/
  3. of 3 veins/
  4. of 4 or more veins/
- #1086. venation <of phyllaries when all alike in 1 row; pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1087. indumentum <of phyllaries when all alike in 1 row; pistillate heads>/
1. glabrous/
  2. scabrous <rough to the touch with short, hard, rigid trichomes>/
  3. scaberulous <minutely scabrous>/
  4. pubescent <soft, short, dense trichomes>/
  5. puberulent <minutely pubescent>/
  6. velutinous <soft, short, dense, straight trichomes; velvety>/
  7. tomentose <soft, short, dense, matted trichomes>/
  8. villous <soft, long, dense, curly, ascending trichomes>/
  9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/
  10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/
  11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/
  12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/
  13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/
  14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/
  15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/
  16. with glandular trichomes/
  17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/
  18. with barbed trichomes/
- #1088. apices <of phyllaries when all alike in 1 row; pistillate heads; shape>/
1. aristate/
  2. caudate/
  3. acuminate/
  4. acute/
  5. cuspidate/
  6. mucronate/
  7. mucronulate/
  8. apiculate/
  9. obtuse/
  10. retuse/
  11. emarginate/
  12. attenuate/
  13. obcordate/
  14. truncate/
  15. rounded/
  16. hooked/
  17. spine-tipped/
- #1089. apices <of phyllaries when all alike in 1 row; pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1090. margins <of phyllaries when all alike in 1 row; pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1091. margins <of phyllaries when all alike in 1 row; pistillate heads>/
1. with fimbriate-ciliate appendages/
  2. with lacerate appendages <e.g., Centaurea>/
  3. with variously shaped appendages <describe>/
- #1092. margins <of phyllaries when all alike in 1 row; pistillate heads; specific color or colors that serves to distinguish the taxon>/
- #1093. margins <of phyllaries when all alike in 1 row; pistillate heads>/
1. entire/
  2. undulate/
  3. sinuate/
  4. crenate/
  5. crenulate/
  6. erose/
  7. serrate/
  8. doubly serrate/
  9. serrulate/
  10. dentate/
  11. denticulate/
  12. incised/
  13. lacerate/
  14. lacinate/
  15. crispate/
  16. ciliate/
  17. spinose/
  18. scarious/
  19. membranous/
- #1094. bases <of phyllaries when all alike in 1 row; pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1095. bases <of phyllaries when all alike in 1 row; pistillate heads; shape>/
1. gibbous <e.g., Pectis>/
  2. not gibbous/
- #1096. bases <of phyllaries when all alike in 1 row; pistillate heads; shape>/
1. keeled <e.g., Pectis>/
  2. not keeled/
- #1097. bases <of phyllaries when all alike in 1 row; pistillate heads; enclosure of outermost achenes>/
1. enclosing outermost achenes/
  2. not enclosing outermost achenes/
- #1098. outer phyllaries <when all alike in 2 or more rows; pistillate heads; number>/
1. 1/
  2. 2/
  3. 3/
  4. 4/
  5. 5/
  6. 6/
  7. 7/
  8. 8/
  9. 9/
  10. 10/
  11. 12 -20/
  12. 20-30/
  13. 30 or more/
- #1099. outer phyllaries <when all alike in 2 or more rows; pistillate heads; distinctive general characters that serve to distinguish the taxon>/
- #1100. outer phyllaries <when all alike in 2 or more rows; pistillate heads; persistence>/
1. caducous/
  2. deciduous/
  3. persistent <implicit>/
- #1101. outer phyllaries <when all alike in 2 or more rows; pistillate heads; imbricate>/
1. imbricate/

2. not imbricate/
- #1102. outer phyllaries <when all alike in 2 or more rows; pistillate heads; fusion>/
1. free/
  2. fused/
  3. fused at bases/
- #1103. outer phyllaries <when all alike in 2 or more rows; pistillate heads; aspect>/
1. appressed/
  2. ascending/
  3. spreading/
  4. reflexed/
  5. curled/
  6. deflexed/
- #1104. outer phyllaries <when all alike in 2 or more rows; pistillate heads; specific color or colors that serves to distinguish the taxon>/
- #1105. outer phyllaries <when all alike in 2 or more rows; pistillate heads; texture>/
1. fleshy/
  2. succulent/
  3. cartilaginous <hard and tough, but flexible>/
  4. chartaceous <papery, opaque and thin>/
  5. coriaceous <leathery>/
  6. fibrous <having loose, woody strands>/
  7. flaccid <lax and weak>/
  8. herbaceous <soft and succulent>/
  9. hyaline <thin and translucent or transparent>/
  10. indurate <hardened>/
  11. membranous <thin and semi-transparent>/
  12. scarious <thin and dry>/
  13. spongy <cellular, sponge-like>/
  14. subherbaceous/
  15. foliaceous <leaf-like>/
- #1106. outer phyllaries <when all alike in 2 or more rows; pistillate heads; shape>/
1. subulate/
  2. acicular/
  3. filiform/
  4. linear/
  5. lanceolate/
  6. oblanceolate/
  7. ovate/
  8. obovate/
  9. elliptic/
  10. oblong/
  11. spatulate/
  12. runcinate/
  13. pandurate/
  14. deltoid/
  15. obdeltoid/
  16. cordate/
  17. obcordate/
  18. reniform/
  19. sagittate/
  20. flabellate/
  21. orbicular/
  22. oval/
  23. ensiform/
  24. squarrose/
  25. concave/
- #1107. outer phyllaries <when all alike in 2 or more rows; pistillate heads; width>/
- mm wide/
- #1108. outer phyllaries <when all alike in 2 or more rows; pistillate heads; length>/
- mm long/
- #1109. outer phyllaries <when all alike in 2 or more rows; pistillate heads; surface>/
1. smooth/
  2. glaucous <waxy covering>/
  3. echinate <stout prickles>/
  4. farinaceous <mealy covering>/
  5. glandular <covered with secretory structures>/
  6. muricate <short, hard protuberances, bumpy>/
  7. resinous <yellowish, sticky exudate>/
  8. scabrous <roughened by short, pointed projections>/
  9. scurfy <mealy; small bran-like scales>/
  10. tuberculate <wart, small swellings>/
  11. punctate <dented; pitted; minute impressions or depressions>/
  12. pulverulent <dusty or powdery>/
  13. rugose <wrinkled or venation impressed in the surface>/
  14. sulcate <longitudinal grooves>/
  15. winged <flat extension>/
  16. alveolate <pitted surface with pits separated by thin partitions; honey-combed>/
  17. ridged/
  18. ribbed/
  19. pustulate <minute blisters>/
  20. striate <longitudinal blisters>/
- #1110. venation <of outer phyllaries when all alike in 2 or more rows; pistillate heads; conspicuousness>/
1. not apparent/
  2. inconspicuous/
  3. conspicuous/
- #1111. venation <of outer phyllaries when all alike in 2 or more rows; pistillate heads; number>/
1. of 1 vein/
  2. of 2 veins/
  3. of 3 veins/
  4. of 4 or more veins/
- #1112. venation <of outer phyllaries when all alike in 2 or more rows; pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1113. indumentum <of outer phyllaries when all alike in 2 or more rows; pistillate heads>/
1. glabrous/
  2. scabrous <rough to the touch with short, hard, rigid trichomes>/
  3. scaberulous <minutely scabrous>/
  4. pubescent <soft, short, dense trichomes>/
  5. puberulent <minutely pubescent>/
  6. velutinous <soft, short, dense, straight trichomes; velvety>/
  7. tomentose <soft, short, dense, matted trichomes>/
  8. villous <soft, long, dense, curly, ascending trichomes>/
  9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/
  10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/
  11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/
  12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/
  13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/
  14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/
  15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/
  16. with glandular trichomes/
  17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/
  18. with barbed trichomes/
- #1114. apices <of outer phyllaries when all alike in 2 or more rows; pistillate heads; shape>/
1. aristate/
  2. caudate/
  3. acuminate/
  4. acute/
  5. cuspidate/
  6. mucronate/
  7. mucronulate/
  8. apiculate/
  9. obtuse/
  10. retuse/
  11. emarginate/

12. attenuate/
  13. obcordate/
  14. truncate/
  15. rounded/
  16. hooked/
  17. spine-tipped/
- #1115. apices <of outer phyllaries when all alike in 2 or more rows; pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1116. margins <of outer phyllaries when all alike in 2 or more rows; pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1117. margins <of outer phyllaries when all alike in 2 or more rows; pistillate heads>/
1. with fimbriate-ciliate appendages/
  2. with lacerate appendages <e.g., Centaurea>/
  3. with variously shaped appendages <describe>/
- #1118. margins <of outer phyllaries when all alike in 2 or more rows; pistillate heads; specific color or colors that serves to distinguish the taxon>/
- #1119. margins <of outer phyllaries when all alike in 2 or more rows; pistillate heads>/
1. entire/
  2. undulate/
  3. sinuate/
  4. crenate/
  5. crenulate/
  6. erose/
  7. serrate/
  8. doubly serrate/
  9. serrulate/
  10. dentate/
  11. denticulate/
  12. incised/
  13. lacerate/
  14. lacinate/
  15. crispate/
  16. ciliate/
  17. spinose/
  18. scarios/
  19. membranous/
- #1120. bases <of outer phyllaries when all alike in 2 or more rows; pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1121. bases <of outer phyllaries when all alike in 2 or more rows; pistillate heads; shape>/
1. gibbous <e.g., Pectis>/
  2. not gibbous/
- #1122. bases <of outer phyllaries when all alike in 2 or more rows; pistillate heads; shape>/
1. keeled <e.g., Pectis>/
  2. not keeled/
- #1123. inner phyllaries <when all alike in 2 or more rows; pistillate heads; number>/
1. 1/
  2. 2/
  3. 3/
  4. 4/
  5. 5/
  6. 6/
  7. 7/
  8. 8/
  9. 9/
  10. 10/
  11. 12 -20/
  12. 20-30/
  13. 30 or more/
- #1124. inner phyllaries <when all alike in 2 or more rows; pistillate heads; distinctive general characters that serve to distinguish the taxon>/
- #1125. inner phyllaries <when all alike in 2 or more rows; pistillate heads; persistence>/
1. caducous/
  2. deciduous/
  3. persistent <implicit>/
- #1126. inner phyllaries <when all alike in 2 or more rows; pistillate heads; imbricate>/
1. imbricate/
  2. not imbricate/
- #1127. inner phyllaries <when all alike in 2 or more rows; pistillate heads; fusion>/
1. free/
  2. fused/
  3. fused at bases/
- #1128. inner phyllaries <when all alike in 2 or more rows; pistillate heads; aspect>/
1. appressed/
  2. ascending/
  3. spreading/
  4. reflexed/
  5. curled/
  6. deflexed/
- #1129. inner phyllaries <when all alike in 2 or more rows; pistillate heads; specific color or colors that serves to distinguish the taxon>/
- #1130. inner phyllaries <when all alike in 2 or more rows; pistillate heads; texture>/
1. fleshy/
  2. succulent/
  3. cartilaginous <hard and tough, but flexible>/
  4. chartaceous <papery, opaque and thin>/
  5. coriaceous <leathery>/
  6. fibrous <having loose, woody strands>/
  7. flaccid <lax and weak>/
  8. herbaceous <soft and succulent>/
  9. hyaline <thin and translucent or transparent>/
  10. indurate <hardened>/
  11. membranous <thin and semi-transparent>/
  12. scarious <thin and dry>/
  13. spongy <cellular, sponge-like>/
  14. subherbaceous/
  15. foliaceous <leaf-like>/
- #1131. inner phyllaries <when all alike in 2 or more rows; pistillate heads; shape>/
1. subulate/
  2. acicular/
  3. filiform/
  4. linear/
  5. lanceolate/
  6. oblanceolate/
  7. ovate/
  8. obovate/
  9. elliptic/
  10. oblong/
  11. spatulate/
  12. runcinate/
  13. pandurate/
  14. deltoid/
  15. obdeltoid/
  16. cordate/
  17. obcordate/
  18. reniform/
  19. sagittate/
  20. flabellate/
  21. orbicular/
  22. oval/
  23. ensiform/
  24. squarrose/
  25. concave/
- #1132. inner phyllaries <when all alike in 2 or more rows; pistillate heads; width>/
- mm wide/



- #1133. inner phyllaries <when all alike in 2 or more rows; pistillate heads; length>/  
mm long/
- #1134. inner phyllaries <when all alike in 2 or more rows; pistillate heads; surface>/  
1. smooth/  
2. glaucous <waxy covering>/  
3. echinate <stout prickles>/  
4. farinaceous <mealy covering>/  
5. glandular <covered with secretory structures>/  
6. muricate <short, hard protuberances, bumpy>/  
7. resinous <yellowish, sticky exudate>/  
8. scabrous <roughened by short, pointed projections>/  
9. scurfy <mealy; small bran-like scales>/  
10. tuberculate <warty, small swellings>/  
11. punctate <dented; pitted; minute impressions or depressions>/  
12. pulverulent <dusty or powdery>/  
13. rugose <wrinkled or venation impressed inot the surface>/  
14. sulcate <longitudinal grooves>/  
15. winged <flat extension>/  
16. alveolate <pitted surface with pits separated by thin partitions; honey-comed>/  
17. ridged/  
18. ribbed/  
19. pustulate <minute blisters>/  
20. striate <longitudinal blisters>/
- #1135. venation <of inner phyllaries when all alike in 2 or more rows; pistillate heads; conspicuousness>/  
1. not apparent/  
2. inconspicuous/  
3. conspicuous/
- #1136. venation <of inner phyllaries when all alike in 2 or more rows; pistillate heads; number>/  
1. of 1 vein/  
2. of 2 veins/  
3. of 3 veins/  
4. of 4 or more veins/
- #1137. venation <of inner phyllaries when all alike in 2 or more rows; pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1138. indumentum <of inner phyllaries when all alike in 2 or more rows; pistillate heads>/  
1. glabrous/  
2. scabrous <rough to the touch with short, hard, rigid trichomes>/  
3. scaberulous <minutely scabrous>/  
4. pubescent <soft, short, dense trichomes>/  
5. puberulent <minutely pubescent>/  
6. velutinous <soft, short, dense, straight trichomes; velvety>/  
7. tomentose <soft, short, dense, matted trichomes>/  
8. villous <soft, long, dense, curly, ascending trichomes>/  
9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/  
10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/  
11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/  
12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/  
13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/  
14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/  
15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/  
16. with glandular trichomes/  
17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/  
18. with barbed trichomes/
- #1139. apices <of inner phyllaries when all alike in 2 or more rows; pistillate heads; shape>/  
1. aristate/  
2. caudate/  
3. acuminate/  
4. acute/  
5. cuspidate/  
6. mucronate/  
7. mucronulate/  
8. apiculate/  
9. obtuse/  
10. retuse/  
11. emarginate/  
12. attenuate/  
13. obcordate/  
14. truncate/  
15. rounded/  
16. hooked/  
17. spine-tipped/
- #1140. apices <of inner phyllaries when all alike in 2 or more rows; pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1141. margins <of inner phyllaries when all alike in 2 or more rows; pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1142. margins <of inner phyllaries when all alike in 2 or more rows; pistillate heads>/  
1. with fimbriate-ciliate appendages/  
2. with lacerate appendages <e.g., Centaurea>/  
3. with variously shaped appendages <describe>/
- #1143. margins <of inner phyllaries when all alike in 2 or more rows; pistillate heads; specific color or colors that serves to distinguish the taxon>/
- #1144. margins <of inner phyllaries when all alike in 2 or more rows; pistillate heads>/  
1. entire/  
2. undulate/  
3. sinuate/  
4. crenate/  
5. crenulate/  
6. erose/  
7. serrate/  
8. doubly serrate/  
9. serrulate/  
10. dentate/  
11. denticulate/  
12. incised/  
13. lacerate/  
14. laciniate/  
15. crispate/  
16. ciliate/  
17. spinose/  
18. scarious/  
19. membranous/
- #1145. bases <of inner phyllaries when all alike in 2 or more rows; pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1146. bases <of inner phyllaries when all alike in 2 or more rows; pistillate heads; shape>/  
1. gibbous <e.g., Pectis>/  
2. not gibbous/
- #1147. bases <of inner phyllaries when all alike in 2 or more rows; pistillate heads; shape>/  
1. keeled <e.g., Pectis>/  
2. not keeled/
- #1148. bases <of inner phyllaries when all alike in 2 or more rows; pistillate heads; enclosure of outermost achenes>/  
1. enclosing outermost achenes/  
2. not enclosing outermost achenes/
- #1149. outer phyllaries <when of 2 or more forms; pistillate heads; number>/  
1. 1/  
2. 2/  
3. 3/

4. 4/
  5. 5/
  6. 6/
  7. 7/
  8. 8/
  9. 9/
  10. 10/
  11. 12 -20/
  12. 20-30/
  13. 30 or more/
- #1150. outer phyllaries <when of 2 or more forms; pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1151. outer phyllaries <when of 2 or more forms; pistillate heads; persistence>/
1. caducous/
  2. deciduous/
  3. persistent <implicit>/
- #1152. outer phyllaries <when of 2 or more forms; pistillate heads; imbricate>/
1. imbricate/
  2. not imbricate/
- #1153. outer phyllaries <when of 2 or more forms; pistillate heads; fusion>/
1. free/
  2. fused/
  3. fused at bases/
- #1154. outer phyllaries <when of 2 or more forms; pistillate heads; aspect>/
1. appressed/
  2. ascending/
  3. spreading/
  4. reflexed/
  5. curled/
  6. deflexed/
- #1155. outer phyllaries <when of 2 or more forms; pistillate heads; specific color or colors that serves to distinguish the taxon>/
- #1156. outer phyllaries <when of 2 or more forms; pistillate heads; texture>/
1. fleshy/
  2. succulent/
  3. cartilaginous <hard and tough, but flexible>/
  4. chartaceous <papery, opaque and thin>/
  5. coriaceous <leathery>/
  6. fibrous <having loose, woody strands>/
  7. flaccid <lax and weak>/
  8. herbaceous <soft and succulent>/
  9. hyaline <thin and translucent or transparent>/
  10. indurate <hardened>/
  11. membranous <thin and semi-transparent>/
  12. scarious <thin and dry>/
  13. spongy <cellular, sponge-like>/
  14. subherbaceous/
  15. foliaceous <leaf-like>/
- #1157. outer phyllaries <when of 2 or more forms; pistillate heads; shape>/
1. subulate/
  2. acicular/
  3. filiform/
  4. linear/
  5. lanceolate/
  6. oblanceolate/
  7. ovate/
  8. obovate/
  9. elliptic/
  10. oblong/
  11. spatulate/
  12. runcinate/
  13. pandurate/
  14. deltoid/
  15. obdeltoid/
  16. cordate/
17. obcordate/
  18. reniform/
  19. sagittate/
  20. flabellate/
  21. orbicular/
  22. oval/
  23. ensiform/
  24. squarrose/
  25. concave/
- #1158. outer phyllaries <when of 2 or more forms; pistillate heads; width>/
- mm wide/
- #1159. outer phyllaries <when of 2 or more forms; pistillate heads; length>/
- mm long/
- #1160. outer phyllaries <when of 2 or more forms; pistillate heads; surface>/
1. smooth/
  2. glaucous <waxy covering>/
  3. echinate <stout prickles>/
  4. farinaceous <mealy covering>/
  5. glandular <covered with secretory structures>/
  6. muricate <short, hard protuberances, bumpy>/
  7. resinous <yellowish, sticky exudate>/
  8. scabrous <roughened by short, pointed projections>/
  9. scurfy <mealy; small bran-like scales>/
  10. tuberculate <warty, small swellings>/
  11. punctate <dented; pitted; minute impressions or depressions>/
  12. pulverulent <dusty or powdery>/
  13. rugose <wrinkled or venation impressed inot the surface>/
  14. sulcate <longitudinal grooves>/
  15. winged <flat extension>/
  16. alveolate <pitted surface with pits separated by thin partitions; honey-comed>/
  17. ridged/
  18. ribbed/
  19. pustulate <minute blisters>/
  20. striate <longitudinal blisters>/
- #1161. venation <of outer phyllaries when of 2 or more forms; pistillate heads; conspicuousness>/
1. not apparent/
  2. inconspicuous/
  3. conspicuous/
- #1162. venation <of outer phyllaries when of 2 or more forms; pistillate heads; number>/
1. of 1 vein/
  2. of 2 veins/
  3. of 3 veins/
  4. of 4 or more veins/
- #1163. venation <of outer phyllaries when of 2 or more forms; pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1164. indumentum <of outer phyllaries when of 2 or more forms; pistillate heads>/
1. glabrous/
  2. scabrous <rough to the touch with short, hard, rigid trichomes>/
  3. scaberulous <minutely scabrous>/
  4. pubescent <soft, short, dense trichomes>/
  5. puberulent <minutely pubescent>/
  6. velutinous <soft, short, dense, straight trichomes; velvety>/
  7. tomentose <soft, short, dense, matted trichomes>/
  8. villous <soft, long, dense, curly, ascending trichomes>/
  9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/
  10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/
  11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/
  12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/

13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/
  14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/
  15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/
  16. with glandular trichomes/
  17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/
  18. with barbed trichomes/
- #1165. apices <of outer phyllaries when of 2 or more forms; pistillate heads; shape>/
1. aristate/
  2. caudate/
  3. acuminate/
  4. acute/
  5. cuspidate/
  6. mucronate/
  7. mucronulate/
  8. apiculate/
  9. obtuse/
  10. retuse/
  11. emarginate/
  12. attenuate/
  13. obcordate/
  14. truncate/
  15. rounded/
  16. hooked/
  17. spine-tipped/
- #1166. apices <of outer phyllaries when of 2 or more forms; pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1167. margins <of outer phyllaries when of 2 or more forms; pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1168. margins <of outer phyllaries when of 2 or more forms; pistillate heads>/
1. with fimbriate-ciliate appendages/
  2. with lacerate appendages <e.g., Centaurea>/
  3. with variously shaped appendages <describe>/
- #1169. margins <of outer phyllaries when of 2 or more forms; pistillate heads; specific color or colors that serves to distinguish the taxon>/
- #1170. margins <of outer phyllaries when of 2 or more forms; pistillate heads>/
1. entire/
  2. undulate/
  3. sinuate/
  4. crenate/
  5. crenulate/
  6. erose/
  7. serrate/
  8. doubly serrate/
  9. serrulate/
  10. dentate/
  11. denticulate/
  12. incised/
  13. lacerate/
  14. laciniate/
  15. crispate/
  16. ciliate/
  17. spinose/
  18. scarious/
  19. membranous/
- #1171. bases <of outer phyllaries when of 2 or more forms; pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1172. bases <of outer phyllaries when of 2 or more forms; pistillate heads; shape>/
1. gibbous <e.g., Pectis>/
  2. not gibbous/
- #1173. bases <of outer phyllaries when of 2 or more forms; pistillate heads; shape>/
1. keeled <e.g., Pectis>/
  2. not keeled/
- #1174. inner phyllaries <when of 2 or more forms; pistillate heads; number>/
1. 1/
  2. 2/
  3. 3/
  4. 4/
  5. 5/
  6. 6/
  7. 7/
  8. 8/
  9. 9/
  10. 10/
  11. 12 -20/
  12. 20-30/
  13. 30 or more/
- #1175. inner phyllaries <when of 2 or more forms; pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1176. inner phyllaries <when of 2 or more forms; pistillate heads; persistence>/
1. caducous/
  2. deciduous/
  3. persistent <implicit>/
- #1177. inner phyllaries <when of 2 or more forms; pistillate heads; imbricate>/
1. imbricate/
  2. not imbricate/
- #1178. inner phyllaries <when of 2 or more forms; pistillate heads; fusion>/
1. free/
  2. fused/
  3. fused at bases/
- #1179. inner phyllaries <when of 2 or more forms; pistillate heads; aspect>/
1. appressed/
  2. ascending/
  3. spreading/
  4. reflexed/
  5. curled/
  6. deflexed/
- #1180. inner phyllaries <when of 2 or more forms; pistillate heads; specific color or colors that serves to distinguish the taxon>/
- #1181. inner phyllaries <when of 2 or more forms; pistillate heads; texture>/
1. fleshy/
  2. succulent/
  3. cartilaginous <hard and tough, but flexible>/
  4. chartaceous <papery, opaque and thin>/
  5. coriaceous <leathery>/
  6. fibrous <having loose, woody strands>/
  7. flaccid <flax and weak>/
  8. herbaceous <soft and succulent>/
  9. hyaline <thin and translucent or transparent>/
  10. indurate <hardened>/
  11. membranous <thin and semi-transparent>/
  12. scarious <thin and dry>/
  13. spongy <cellular, sponge-like>/
  14. subherbaceous/
  15. foliaceous <leaf-like>/
- #1182. inner phyllaries <when of 2 or more forms; pistillate heads; shape>/
1. subulate/
  2. acicular/
  3. filiform/
  4. linear/
  5. lanceolate/
  6. oblanceolate/

7. ovate/
  8. obovate/
  9. elliptic/
  10. oblong/
  11. spatulate/
  12. runcinate/
  13. pandurate/
  14. deltoid/
  15. obdeltoid/
  16. cordate/
  17. obcordate/
  18. reniform/
  19. sagittate/
  20. flabellate/
  21. orbicular/
  22. oval/
  23. ensiform/
  24. squarrose/
  25. concave/
- #1183. inner phyllaries <when of 2 or more forms; pistillate heads; width>/  
mm wide/
- #1184. inner phyllaries <when of 2 or more forms; pistillate heads; length>/  
mm long/
- #1185. inner phyllaries <when of 2 or more forms; pistillate heads; surface>/
1. smooth/
  2. glaucous <waxy covering>/
  3. echinate <stout prickles>/
  4. farinaceous <mealy covering>/
  5. glandular <covered with secretory structures>/
  6. muricate <short, hard protuberances, bumpy>/
  7. resinous <yellowish, sticky exudate>/
  8. scabrous <roughened by short, pointed projections>/
  9. scurfy <mealy; small bran-like scales>/
  10. tuberculate <wartlike, small swellings>/
  11. punctate <dented; pitted; minute impressions or depressions>/
  12. pulverulent <dusty or powdery>/
  13. rugose <wrinkled or venation impressed in the surface>/
  14. sulcate <longitudinal grooves>/
  15. winged <flat extension>/
  16. alveolate <pitted surface with pits separated by thin partitions; honey-combed>/
  17. ridged/
  18. ribbed/
  19. pustulate <minute blisters>/
  20. striate <longitudinal blisters>/
- #1186. venation <of inner phyllaries when of 2 or more forms; pistillate heads; conspicuousness>/
1. not apparent/
  2. inconspicuous/
  3. conspicuous/
- #1187. venation <of inner phyllaries when of 2 or more forms; pistillate heads; number>/
1. of 1 vein/
  2. of 2 veins/
  3. of 3 veins/
  4. of 4 or more veins/
- #1188. venation <of inner phyllaries when of 2 or more forms; pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1189. indumentum <of inner phyllaries when of 2 or more forms; pistillate heads>/
1. glabrous/
  2. scabrous <rough to the touch with short, hard, rigid trichomes>/
  3. scaberulous <minutely scabrous>/
  4. pubescent <soft, short, dense trichomes>/
  5. puberulent <minutely pubescent>/
  6. velutinous <soft, short, dense, straight trichomes; velvety>/
  7. tomentose <soft, short, dense, matted trichomes>/
  8. villous <soft, long, dense, curly, ascending trichomes>/
  9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/
  10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/
  11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/
  12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/
  13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/
  14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/
  15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/
  16. with glandular trichomes/
  17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/
  18. with barbed trichomes/
- #1190. apices <of inner phyllaries when of 2 or more forms; pistillate heads; shape>/
1. aristate/
  2. caudate/
  3. acuminate/
  4. acute/
  5. cuspidate/
  6. mucronate/
  7. mucronulate/
  8. apiculate/
  9. obtuse/
  10. retuse/
  11. emarginate/
  12. attenuate/
  13. obcordate/
  14. truncate/
  15. rounded/
  16. hooked/
  17. spine-tipped/
- #1191. apices <of inner phyllaries when of 2 or more forms; pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1192. margins <of inner phyllaries when of 2 or more forms; pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1193. margins <of inner phyllaries when of 2 or more forms; pistillate heads>/
1. with fimbriate-ciliate appendages/
  2. with lacerate appendages <e.g., Centaurea>/
  3. with variously shaped appendages <describe>/
- #1194. margins <of inner phyllaries when of 2 or more forms; pistillate heads; specific color or colors that serves to distinguish the taxon>/
- #1195. margins <of inner phyllaries when of 2 or more forms; pistillate heads>/
1. entire/
  2. undulate/
  3. sinuate/
  4. crenate/
  5. crenulate/
  6. erose/
  7. serrate/
  8. doubly serrate/
  9. serrulate/
  10. dentate/
  11. denticulate/
  12. incised/
  13. lacerate/
  14. lacinate/
  15. crispate/
  16. ciliate/
  17. spinose/
  18. scarious/
  19. membranous/

- #1196. bases <of inner phyllaries when of 2 or more forms; pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1197. bases <of inner phyllaries when of 2 or more forms; pistillate heads; shape>/  
1. gibbous <e.g., Pectis>/  
2. not gibbous/
- #1198. bases <of inner phyllaries when of 2 or more forms; pistillate heads; shape>/  
1. keeled <e.g., Pectis>/  
2. not keeled/
- #1199. bases <of inner phyllaries when of 2 or more forms; pistillate heads; enclosure of outermost achenes>/  
1. enclosing outermost achenes/  
2. not enclosing outermost achenes/
- #1200. ray florets <of pistillate heads; presence>/  
1. present/  
2. absent/
- #1201. ray florets <of pistillate heads; number>/  
1. 2/  
2. 3/  
3. 4/  
4. 5/  
5. 6/  
6. 7/  
7. 8/  
8. 9/  
9. 10-20/  
10. 20 or more/
- #1202. ray florets <of pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1203. ray florets <of pistillate heads; rows>/  
1. in 1 row/  
2. in 2 rows/  
3. in 3 or more rows/
- #1204. ray florets <of pistillate heads; number per row, when in more than 1 whorl>/
- #1205. ray florets <of pistillate heads; sexuality>  
<MANDATORY>/  
1. perfect/  
2. pistillate/  
3. staminate/  
4. neuter/  
5. perfect, but functionally pistillate/  
6. perfect, but functionally pistillate/
- #1206. ray florets <of pistillate heads; fertility; producing achenes>/  
1. fertile/  
2. sterile/
- #1207. pappus <of ray florets of pistillate heads; presence>/  
1. absent/  
2. present; in 1 whorl/  
3. present; in 2 whorls <double>/
- #1208. pappus <of ray florets when in 1 whorl; pistillate heads; morphological forms>/  
1. of awns/  
2. of scales/  
3. of teeth/  
4. of appressed teeth/  
5. of capillary hairs/  
6. of capillary bristles/  
7. of bristles/  
8. of scabrous bristles/  
9. of stiff bristles/  
10. of plumose bristles/  
11. coroniform/  
12. of barbellate bristles/  
13. of scarious scales/  
14. of smooth bristles/  
15. of hairs/  
16. an adaxial auricle <e.g., Anthemis>/  
17. of bristlelike scales/  
18. of stiff scales/  
19. of subclavate hairs/  
20. of subulate hairs <awl-shaped>/  
21. a crenulate rim <e.g., Heliopsis>/  
22. of barbellate awns/  
23. of retrorsely hispid awns/  
24. of fimbriate awns/  
25. of elongate awns/  
26. of serrulate awns/
- #1209. pappus <of ray florets of pistillate heads; number of parts>/  
1. 1/  
2. 2/  
3. 3/  
4. 4/  
5. 5/  
6. 6/  
7. 7/  
8. 8/  
9. 9/  
10. 10/  
11. 11/  
12. 12 or more/  
13. numerous <number, if countable>/
- #1210. pappus <of ray florets when in 1 whorl; pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1211. pappus <of ray florets when in 1 whorl; pistillate heads; persistence>/  
1. caducous/  
2. persistent in fruit/  
3. not persistent in fruit/
- #1212. pappus <of ray florets when in 1 whorl; pistillate heads; fusion>/  
1. free/  
2. fused/  
3. fused at bases/
- #1213. pappus <of ray florets when in 1 whorl; pistillate heads; aspect>/  
1. appressed/  
2. ascending/  
3. spreading/  
4. reflexed/  
5. curled/
- #1214. pappus <of ray florets when in 1 whorl; pistillate heads; specific color or colors that serves to distinguish the taxon>/
- #1215. pappus <of ray florets when in 1 whorl; pistillate heads; nature>/  
1. fragile/  
2. stout/
- #1216. pappus <of ray florets when in 1 whorl; pistillate heads; nature>/  
1. slender/  
2. thick/  
3. flattened on outer sides <e.g., Brickellia>/
- #1217. pappus <of ray florets when in 1 whorl; pistillate heads; width>/  
mm wide/
- #1218. pappus <of ray florets when in 1 whorl; pistillate heads; equality in length>/  
1. all equal in length/  
2. unequal in length/
- #1219. pappus <of ray florets when in 1 whorl; pistillate heads; length>/  
mm long/

- #1220. indumentum <of pappus of ray florets when in 1 whorl; pistillate heads>/  
 1. glabrous/  
 2. scabrous <rough to the touch with short, hard, rigid trichomes>/  
 3. scaberulous <minutely scabrous>/  
 4. pubescent <soft, short, dense trichomes>/  
 5. puberulent <minutely pubescent>/  
 6. velutinous <soft, short, dense, straight trichomes; velvety>/  
 7. tomentose <soft, short, dense, matted trichomes>/  
 8. villous <soft, long, dense, curly, ascending trichomes>/  
 9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/  
 10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/  
 11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/  
 12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/  
 13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/  
 14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/  
 15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/  
 16. with glandular trichomes/  
 17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/  
 18. with barbed trichomes/
- #1221. apices <of pappus of ray florets when in 1 whorl; pistillate heads; shape>/  
 1. rounded/  
 2. obtuse/  
 3. acute/  
 4. acuminate/
- #1222. apices <of pappus of ray florets when in 1 whorl; pistillate heads>/  
 1. with midribs excurrent as awns/  
 2. with midribs not excurrent as awns/
- #1223. margins <of pappus of ray florets when in 1 whorl; pistillate heads>/  
 1. entire/  
 2. undulate/  
 3. sinuate/  
 4. crenate/  
 5. crenulate/  
 6. erose/  
 7. serrate/  
 8. doubly serrate/  
 9. serrulate/  
 10. dentate/  
 11. denticulate/  
 12. incised/  
 13. lacerate/  
 14. laciniate/  
 15. crispate/  
 16. ciliate/  
 17. spinose/  
 18. scarious/  
 19. membranous/
- #1224. bases <of pappus of ray florets when in 1 whorl; pistillate heads; nature>/  
 1. wide/  
 2. narrow/
- #1225. bases <of pappus of ray florets when in 1 whorl; pistillate heads; nature>/  
 1. thick/  
 2. thin/
- #1226. bases <of pappus of ray florets when in 1 whorl; pistillate heads; nature>/  
 1. straight/  
 2. curved/
- #1227. outer pappus <of ray florets when in 2 whorls; pistillate heads; morphological forms>/  
 1. of awns/  
 2. of scales/  
 3. of teeth/  
 4. of appressed teeth/  
 5. of capillary hairs/  
 6. of capillary bristles/  
 7. of bristles/  
 8. of scabrous bristles/  
 9. of stiff bristles/  
 10. of plumose bristles/  
 11. coroniform/  
 12. of barbellate bristles/  
 13. of scarious scales/  
 14. of smooth bristles/  
 15. of hairs/  
 16. an adaxial auricle <e.g., Anthemis>/  
 17. of bristlelike scales/  
 18. of stiff scales/  
 19. of subclavate hairs/  
 20. of subulate hairs <awl-shaped>/  
 21. a crenulate rim <e.g., Heliopsis>/  
 22. of barbellate awns/  
 23. of retrorsely hispid awns/  
 24. of fimbriate awns/  
 25. of elongate awns/  
 26. of serrulate awns/
- #1228. outer pappus <of ray florets when in 2 whorls; pistillate heads; number of parts>/  
 1. 1/  
 2. 2/  
 3. 3/  
 4. 4/  
 5. 5/  
 6. 6/  
 7. 7/  
 8. 8/  
 9. 9/  
 10. 10/  
 11. 11/  
 12. 12 or more/  
 13. numerous <number, if countable>/
- #1229. outer pappus <of ray florets when in 2 whorls; pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1230. outer pappus <of ray florets when in 2 whorls; pistillate heads; persistence>/  
 1. caducous/  
 2. persistent in fruit/  
 3. not persistent in fruit/
- #1231. outer pappus <of ray florets when in 2 whorls; pistillate heads; fusion>/  
 1. free/  
 2. fused/  
 3. fused at bases/
- #1232. outer pappus <of ray florets when in 2 whorls; pistillate heads; aspect>/  
 1. appressed/  
 2. ascending/  
 3. spreading/  
 4. reflexed/  
 5. curled/
- #1233. outer pappus <of ray florets when in 2 whorls; pistillate heads; specific color or colors that serves to distinguish the taxon>/
- #1234. outer pappus <of ray florets when in 2 whorls; pistillate heads; nature>/  
 1. fragile/  
 2. stout/
- #1235. outer pappus <of ray florets when in 2 whorls; pistillate heads; nature>/  
 1. slender/

2. thick/  
3. flattened on outer sides <e.g., Brickellia>/
- #1236. outer pappus <of ray florets when in 2 whorls; pistillate heads; width>/  
mm wide/
- #1237. outer pappus <of ray florets when in 2 whorls; pistillate heads; equality in length>/  
1. all equal in length/  
2. unequal in length/
- #1238. outer pappus <of ray florets when in 2 whorls; pistillate heads; length>/  
mm long/
- #1239. indumentum <of outer pappus of ray florets when in 2 whorls; pistillate heads>/  
1. glabrous/  
2. scabrous <rough to the touch with short, hard, rigid trichomes>/  
3. scaberulous <minutely scabrous>/  
4. pubescent <soft, short, dense trichomes>/  
5. puberulent <minutely pubescent>/  
6. velutinous <soft, short, dense, straight trichomes; velvety>/  
7. tomentose <soft, short, dense, matted trichomes>/  
8. villous <soft, long, dense, curly, ascending trichomes>/  
9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/  
10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/  
11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/  
12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/  
13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/  
14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/  
15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/  
16. with glandular trichomes/  
17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/  
18. with barbed trichomes/
- #1240. apices <of outer pappus of ray florets when in 2 whorls; pistillate heads; shape>/  
1. rounded/  
2. obtuse/  
3. acute/  
4. acuminate/
- #1241. apices <of outer pappus of ray florets when in 2 whorls; pistillate heads>/  
1. with midribs excurrent as awns/  
2. midribs not excurrent as awns/
- #1242. margins <of outer pappus of ray florets when in 2 whorls; pistillate heads>/  
1. entire/  
2. undulate/  
3. sinuate/  
4. crenate/  
5. crenulate/  
6. erose/  
7. serrate/  
8. doubly serrate/  
9. serrulate/  
10. dentate/  
11. denticulate/  
12. incised/  
13. lacerate/  
14. laciniate/  
15. crispate/  
16. ciliate/  
17. spinose/  
18. scarious/  
19. membranous/
- #1243. bases <of outer pappus of ray florets when in 2 whorls; pistillate heads; nature>/  
1. wide/  
2. narrow/
- #1244. bases <of outer pappus of ray florets when in 2 whorls; pistillate heads; nature>/  
1. thick/  
2. thin/
- #1245. bases <of outer pappus of ray florets when in 2 whorls; pistillate heads; nature>/  
1. straight/  
2. curved/
- #1246. inner pappus <of ray florets when in 2 whorls; pistillate heads; morphological forms>/  
1. of awns/  
2. of scales/  
3. of teeth/  
4. of appressed teeth/  
5. of capillary hairs/  
6. of capillary bristles/  
7. of bristles/  
8. of scabrous bristles/  
9. of stiff bristles/  
10. of plumose bristles/  
11. coroniform/  
12. of barbellate bristles/  
13. of scarious scales/  
14. of smooth bristles/  
15. of hairs/  
16. an adaxial auricle <e.g., Anthemis>/  
17. of bristlelike scales/  
18. of stiff scales/  
19. of subclavate hairs/  
20. of subulate hairs <awl-shaped>/  
21. a crenulate rim <e.g., Heliopsis>/  
22. of barbellate awns/  
23. of retrorsely hispid awns/  
24. of fimbriate awns/  
25. of elongate awns/  
26. of serrulate awns/
- #1247. inner pappus <of ray florets when in 2 whorls; pistillate heads; number of parts>/  
1. 1/  
2. 2/  
3. 3/  
4. 4/  
5. 5/  
6. 6/  
7. 7/  
8. 8/  
9. 9/  
10. 10/  
11. 11/  
12. 12 or more/  
13. numerous <number, if countable>/
- #1248. inner pappus <of ray florets when in 2 whorls; pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1249. inner pappus <of ray florets when in 2 whorls; pistillate heads; persistence>/  
1. caducous/  
2. persistent in fruit/  
3. not persistent in fruit/
- #1250. inner pappus <of ray florets when in 2 whorls; pistillate heads; fusion>/  
1. free/  
2. fused/  
3. fused at bases/
- #1251. inner pappus <of ray florets when in 2 whorls; pistillate heads; aspect>/  
1. appressed/  
2. ascending/  
3. spreading/

4. reflexed/
  5. curled/
- #1252. inner pappus <of ray florets when in 2 whorls; pistillate heads; specific color or colors that serves to distinguish the taxon>/
- #1253. inner pappus <of ray florets when in 2 whorls; pistillate heads; nature>/
1. fragile/
  2. stout/
- #1254. inner pappus <of ray florets when in 2 whorls; pistillate heads; nature>/
1. slender/
  2. thick/
  3. flattened on outer sides <e.g., Brickellia>/
- #1255. inner pappus <of ray florets when in 2 whorls; pistillate heads; width>/
- mm wide/
- #1256. inner pappus <of ray florets when in 2 whorls; pistillate heads; equality in length>/
1. all equal in length/
  2. unequal in length/
- #1257. inner pappus <of ray florets when in 2 whorls; pistillate heads; length>/
- mm long/
- #1258. indumentum <of inner pappus of ray florets when in 2 whorls; pistillate heads>/
1. glabrous/
  2. scabrous <rough to the touch with short, hard, rigid trichomes>/
  3. scaberulous <minutely scabrous>/
  4. pubescent <soft, short, dense trichomes>/
  5. puberulent <minutely pubescent>/
  6. velutinous <soft, short, dense, straight trichomes; velvety>/
  7. tomentose <soft, short, dense, matted trichomes>/
  8. villous <soft, long, dense, curly, ascending trichomes>/
  9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/
  10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/
  11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/
  12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/
  13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/
  14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/
  15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/
  16. with glandular trichomes/
  17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/
  18. with barbed trichomes/
- #1259. apices <of inner pappus of ray florets when in 2 whorls; pistillate heads; shape>/
1. rounded/
  2. obtuse/
  3. acute/
  4. acuminate/
- #1260. apices <of inner pappus of ray florets when in 2 whorls; pistillate heads>/
1. with midribs excurrent as awns/
  2. with midribs not excurrent as awns/
- #1261. margins <of inner pappus of ray florets when in 2 whorls; pistillate heads>/
1. entire/
  2. undulate/
  3. sinuate/
  4. crenate/
  5. crenulate/
6. erose/
  7. serrate/
  8. doubly serrate/
  9. serrulate/
  10. dentate/
  11. denticulate/
  12. incised/
  13. lacerate/
  14. lacinate/
  15. crispate/
  16. ciliate/
  17. spinose/
  18. scarious/
  19. membranous/
- #1262. bases <of inner pappus of ray florets when in 2 whorls; pistillate heads; nature>/
1. wide/
  2. narrow/
- #1263. bases <of inner pappus of ray florets when in 2 whorls; pistillate heads; nature>/
1. thick/
  2. thin/
- #1264. bases <of inner pappus of ray florets when in 2 whorls; pistillate heads; nature>/
1. straight/
  2. curved/
- #1265. corollas <of ray florets of pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1266. corollas <of ray florets of pistillate heads; differentiation>/
1. differentiated into limbs and tubes <implicit>/
  2. not differentiated, limbs absent and tubes present/
  3. not differentiated, limbs present and tubes absent <e.g., Zinnia>/
- #1267. corollas <of ray florets of pistillate heads; fusion of lobes>/
1. not lobed/
  2. 2-lobed/
  3. shallowly 3-lobed/
  4. deeply 3-lobed/
  5. 4-lobed/
  6. 5-lobed/
- #1268. corollas <of ray florets of pistillate heads; persistence>/
1. cauducous/
  2. persistent at maturity/
  3. deciduous at maturity/
- #1269. corollas <of ray florets of pistillate heads; aspect>/
1. erect/
  2. ascending/
  3. spreading/
  4. reflexed/
  5. curled/
- #1270. corollas <of ray florets of pistillate heads; specific color or colors that serves to distinguish the taxon>/
- #1271. corollas <of ray florets of pistillate heads; limb texture>/
1. membranous/
  2. fleshy/
  3. succulent/
  4. cartilaginous <hard and tough, but flexible>/
  5. chartaceous <papery, opaque and thin, e.g., Hymenoxys>/
  6. coriaceous <leathery>/
  7. flaccid <lax and weak>/
  8. herbaceous <soft and succulent>/
  9. hyaline <thin and translucent or transparent>/
  10. indurate <hardened>/
  11. scarious <thin and dry>/
- #1272. corollas <of ray florets of pistillate heads; limb shape>/
1. spatulate/



2. cucullate/
  3. linear/
  4. emarginate/
  5. bifid/
  6. rhomboid/
  7. deltoid/
  8. triangular/
  9. ovate/
  10. lanceolate/
  11. oblanceolate/
  12. obovate/
  13. oblong/
  14. orbicular/
- #1273. corollas <of ray florets of pistillate heads; width>/  
mm wide/
- #1274. corollas <of ray florets of pistillate heads; length  
including length of tube>/  
mm long/
- #1275. corollas <of ray florets of pistillate heads; venation>/
1. 3-veined/
  2. 4-veined/
  3. 5-veined/
  4. many veined/
- #1276. indumentum <of corollas of ray florets; pistillate  
heads>/
1. glabrous/
  2. scabrous <rough to the touch with short, hard, rigid  
trichomes>/
  3. scaberulous <minutely scabrous>/
  4. pubescent <soft, short, dense trichomes>/
  5. puberulent <minutely pubescent>/
  6. velutinous <soft, short, dense, straight trichomes;  
velvety>/
  7. tomentose <soft, short, dense, matted trichomes>/
  8. villous <soft, long, dense, curly, ascending trichomes>/
  9. sericeous <soft, long, dense or sparse, appressed,  
straight trichomes; silky>/
  10. lanate <soft, long, dense, matted, ascending, curly  
trichomes; woolly>/
  11. pilose <soft, long, sparse, ascending, curly or straight  
trichomes>/
  12. arachnoid <soft, very long, dense, thin, loosely  
entangled trichomes; cobwebby>/
  13. hirsute <stiff, long, dense or sparse, erect or  
ascending, straight trichomes>/
  14. hispid <stiff, long, tapered, dense or sparse, erect or  
ascending, straight trichomes; bristly>/
  15. strigose <stiff, long, sharp, bulbous base, dense or  
sparse, appressed, straight or curved trichomes>/
  16. with glandular trichomes/
  17. stellate <trichomes with branches radiating from base  
or separate hairs aggregated into star-like clusters>/
  18. with barbed trichomes/
- #1277. indumentation <of corollas of ray florets; pistillate  
heads; description of indumentation and location that  
serves to distinguish the taxon>/
- #1278. apices <of corollas of ray florets; pistillate heads;  
shape>/
1. rounded/
  2. obtuse/
  3. acute/
  4. acuminate/
- #1279. bases of corolla tubes <of ray florets of pistillate heads;  
enlargement>/
1. not enlarged in fruit <implicit>/
  2. slightly saccate in fruit <e.g., Achillea>/
  3. swollen in fruit/
- #1280. stamens <of ray florets of pistillate heads; presence>/
1. present/
  2. absent/
- #1281. stamens <of ray florets of pistillate heads; number>/
1. 3/
2. 4/
  3. 5/
- #1282. stamens <of ray florets of pistillate heads; distinctive,  
general characters that serve to distinguish the taxon>/
- #1283. stamens <of ray florets of pistillate heads; length>/  
mm long/
- #1284. stamens <of ray florets of pistillate heads; fusion>/
1. free/
  2. fused by filaments/
  3. fused by anthers <implicit>/
- #1285. anthers <of ray florets of pistillate heads; distinctive,  
general characteristics that serve to distinguish the  
taxon>/
- #1286. anthers <of ray florets of pistillate heads; specific color  
or colors that serves to distinguish the taxon>/
- #1287. anthers <of ray florets of pistillate heads; straightness>/
1. straight/
  2. curved/
- #1288. anthers <of ray florets of pistillate heads; width>/  
mm wide/
- #1289. anthers <of ray florets of pistillate heads; length>/  
mm long/
- #1290. apical appendages <of anthers of ray florets; pistillate  
heads; presence>/
1. present/
  2. absent/
- #1291. apical appendages <of anthers of ray florets; pistillate  
heads; appearance>/
1. flat/
  2. keeled/
  3. curved/
- #1292. apical appendages <of anthers of ray florets; pistillate  
heads; shape>/
1. linear/
  2. lanceolate/
  3. subulate/
  4. spatulate/
- #1293. apical appendages <of anthers of ray florets; pistillate  
heads; width>/  
mm wide/
- #1294. apical appendages <of anthers of ray florets; pistillate  
heads; length>/  
mm long/
- #1295. thecae <of anthers of ray florets; pistillate heads;  
distinctive, general characteristics that serve to distinguish  
the taxon>/
- #1296. bases <of anthers of ray florets; pistillate heads;  
shape>/
1. obtuse/
  2. subtruncate/
  3. rounded/
  4. sagittate/
  5. caudate <tailed>/
- #1297. connective tissue <of anthers of ray florets; pistillate  
heads; distinctive, general characters that serve to  
distinguish the taxon>/
- #1298. pollen <of ray florets of pistillate heads; distinctive,  
general characters that serve to distinguish the taxon>/
- #1299. filaments <of ray florets of pistillate heads; distinctive,  
general characters that serve to distinguish the taxon>/
- #1300. styles <of ray florets of pistillate heads; presence>/
1. present <implicit>/

2. absent/
- #1301. styles <of ray florets of pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1302. styles <of ray florets of pistillate heads; division>/  
1. divided/  
2. not divided/
- #1303. styles <of ray florets of pistillate heads; describe degree of division if serves to distinguish the taxon>/
- #1304. styles <of ray florets of pistillate heads; length>/  
mm long/
- #1305. styles <of ray florets of pistillate heads; length relative to corolla tubes>/  
1. exerted beyond corolla tubes/  
2. included within corolla tubes/  
3. equalling corolla tubes/
- #1306. style branches <of ray florets of pistillate heads; presence>/  
1. present/  
2. absent/
- #1307. style branches <of ray florets of pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1308. style branches <of ray florets of pistillate heads; lobing>/  
1. not lobed/  
2. 2-lobed/
- #1309. style branches <of ray florets of pistillate heads; color or colors that serves to distinguish the taxon>/
- #1310. style branches <of ray florets of pistillate heads; shape>/  
1. linear/  
2. clavate/  
3. filiform/  
4. lanceolate/
- #1311. style branches <of ray florets of pistillate heads; organization of stigmatic regions>/  
1. stigmatic regions on adaxial surfaces/  
2. stigmatic regions forming 2 marginal bands/
- #1312. indumentum <of style branches of ray florets; pistillate heads>/  
1. glabrous/  
2. scabrous <rough to the touch with short, hard, rigid trichomes>/  
3. scaberulous <minutely scabrous>/  
4. pubescent <soft, short, dense trichomes>/  
5. puberulent <minutely pubescent>/  
6. velutinous <soft, short, dense, straight trichomes; velvety>/  
7. tomentose <soft, short, dense, matted trichomes>/  
8. villous <soft, long, dense, curly, ascending trichomes>/  
9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/  
10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/  
11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/  
12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/  
13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/  
14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/  
15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/  
16. with glandular trichomes/  
17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/  
18. with barbed trichomes/
- #1313. sterile appendages <of style branches of ray florets; pistillate heads; presence>/  
1. present/  
2. absent/
- #1314. apices <of style branches of ray florets; pistillate heads; shape>/  
1. attenuate/  
2. broadly rounded/  
3. truncate/  
4. obtuse/  
5. acute/  
6. acuminate/  
7. triangular/
- #1315. bases <of styles of ray florets; pistillate heads; nature>/  
1. swollen/  
2. not swollen/  
3. not swollen but with shaft enlarged/
- #1316. bases <of styles of ray florets; pistillate heads; nectaries>/  
1. nectaries present/  
2. nectaries absent/
- #1317. indumentum <of bases of styles of ray florets; pistillate heads>/  
1. glabrous/  
2. scabrous <rough to the touch with short, hard, rigid trichomes>/  
3. scaberulous <minutely scabrous>/  
4. pubescent <soft, short, dense trichomes>/  
5. puberulent <minutely pubescent>/  
6. velutinous <soft, short, dense, straight trichomes; velvety>/  
7. tomentose <soft, short, dense, matted trichomes>/  
8. villous <soft, long, dense, curly, ascending trichomes>/  
9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/  
10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/  
11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/  
12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/  
13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/  
14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/  
15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/  
16. with glandular trichomes/  
17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/  
18. with barbed trichomes/
- #1318. sweeping hairs <on styles and style branches of ray florets; pistillate heads; presence>/  
1. present/  
2. absent/
- #1319. sweeping hairs <on styles and style branches of ray florets; pistillate heads; arrangement>/  
1. scattered abaxially along style branches and extending down shafts of styles <e.g., Vernonia>/  
2. in ring on shafts below style branches <e.g., Cardus>/  
3. concentrated on tips of style branches/  
4. forming terminal truncate brushes on style branches <e.g., Senecio>/
- #1320. sweeping hairs <on styles and style branches of ray florets; pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1321. achenes <of ray florets; pistillate heads; presence>/  
1. present/  
2. absent/
- #1322. achenes <of ray florets of pistillate heads; distinctiveness>/  
1. vestigial/

2. developed/
- #1323. achenes <of ray florets of pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1324. achenes <of ray florets of pistillate heads; color or colors that serve to distinguish the taxon>/
- #1325. achenes <of ray florets of pistillate heads; surface>/
1. smooth/
  2. glandular/
  3. spiny/
  4. rugulose/
  5. setose <covered with bristles>/
  6. muricate/
  7. tuberculate/
  8. undulating/
  9. rugose/
  10. sulcate/
  11. striate/
- #1326. achenes <of ray florets of pistillate heads; shape in cross-section>/
1. angular/
  2. terete/
  3. trigonous/
  4. tetragonous/
  5. pentagonous/
  6. flattened/
  7. lenticular/
- #1327. achenes <of ray florets of pistillate heads; shape in longitudinal-section>/
1. columnar/
  2. conical/
  3. fusiform/
  4. ovate/
  5. oblong/
  6. obconical/
  7. elliptic/
  8. obovate/
  9. oblanceolate/
  10. lanceolate/
  11. linear/
  12. clavate/
  13. cylindrical/
- #1328. achenes <of ray florets of pistillate heads; width>/ mm wide/
- #1329. achenes <of ray florets of pistillate heads; length>/ mm long/
- #1330. indumentum <of achenes of ray florets; pistillate heads>/
1. glabrous/
  2. scabrous <rough to the touch with short, hard, rigid trichomes>/
  3. scaberulous <minutely scabrous>/
  4. pubescent <soft, short, dense trichomes>/
  5. puberulent <minutely pubescent>/
  6. velutinous <soft, short, dense, straight trichomes; velvety>/
  7. tomentose <soft, short, dense, matted trichomes>/
  8. villous <soft, long, dense, curly, ascending trichomes>/
  9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/
  10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/
  11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/
  12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/
  13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/
  14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/
  15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/
  16. with glandular trichomes/
  17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/
  18. with barbed trichomes/
- #1331. indumentum <of achenes of ray florets; pistillate heads; location; descriptors for location of hairs that serve to characterize the taxon>/
- #1332. ribs <of achenes of ray florets; pistillate heads; presence>/
1. present/
  2. absent/
- #1333. ribs <of achenes of ray florets; pistillate heads; number>/
1. 1/
  2. 2/
  3. 3/
  4. 4/
  5. 5/
  6. 6/
  7. 7/
  8. 8/
  9. 9/
  10. 10/
  11. 12 or more/
- #1334. ribs <of achenes of ray florets; pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1335. ribs <of achenes of ray florets; pistillate heads; conspicuousness>/
1. conspicuous/
  2. inconspicuous/
- #1336. wings <of achenes of ray florets; pistillate heads; presence>/
1. present/
  2. absent/
- #1337. wings <of achenes of ray florets; pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1338. wings <of achenes of ray florets; pistillate heads; position>/
1. continuous from apices to bases/
  2. primarily apical/
  3. primarily basal/
- #1339. beaks <of achenes of ray florets; pistillate heads; presence>/
1. present/
  2. absent/
- #1340. beaks <of achenes of ray florets; pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1341. beaks <of achenes of ray florets; pistillate heads; curvature>/
1. curved/
  2. not curved/
- #1342. beaks <of achenes of ray florets; pistillate heads; specific color or colors that serve to distinguish the taxon>/
- #1343. beaks <of achenes of ray florets; pistillate heads; length>/ mm long/
- #1344. bases <of achenes of ray florets; pistillate heads; attachment>/
1. attached to subtending receptacular bracts/
  2. not attached to subtending receptacular bracts/
- #1345. disk florets <of pistillate heads; presence>/
1. present/
  2. absent/

- #1346. disk florets <of pistillate heads; number> /  
 1. 2 /  
 2. 3 /  
 3. 4 /  
 4. 5 /  
 5. 6 /  
 6. 7 /  
 7. 8 /  
 8. 9 /  
 9. 10-20 /  
 10. 20 or more /
- #1347. disk florets <of pistillate heads; distinctive, general characters that serve to distinguish the taxon> /
- #1348. disk florets <of pistillate heads; sexuality>  
 <MANDATORY> /  
 1. perfect /  
 2. pistillate /  
 3. staminate /  
 4. neuter /  
 5. perfect, but functionally pistillate /  
 6. perfect, but functionally staminate /
- #1349. disk florets <of pistillate heads; fertility; producing achenes> /  
 1. fertile /  
 2. sterile /
- #1350. pappus <of disk florets of pistillate heads; presence> /  
 1. absent /  
 2. present; in 1 whorl /  
 3. present; in 2 whorls <double> /
- #1351. pappus <of disk florets when in 1 whorl; pistillate heads; morphological forms> /  
 1. of awns /  
 2. of scales /  
 3. of teeth /  
 4. of appressed teeth /  
 5. of capillary hairs /  
 6. of capillary bristles /  
 7. of bristles /  
 8. of scabrous bristles /  
 9. of stiff bristles /  
 10. of plumose bristles /  
 11. coroniform /  
 12. of barbellate bristles /  
 13. of scarious scales /  
 14. of smooth bristles /  
 15. of hairs /  
 16. an adaxial auricle <e.g., Anthemis> /  
 17. of bristlelike scales /  
 18. of stiff scales /  
 19. of subclavate hairs /  
 20. of subulate hairs <awl-shaped> /  
 21. a crenulate rim <e.g., Heliopsis> /  
 22. of barbellate awns /  
 23. of retrorsely hispid awns /  
 24. of fimbriate awns /  
 25. of elongate awns /  
 26. of serrulate awns /
- #1352. pappus <of disk florets when in 1 whorl; pistillate heads; number of parts> /  
 1. 1 /  
 2. 2 /  
 3. 3 /  
 4. 4 /  
 5. 5 /  
 6. 6 /  
 7. 7 /  
 8. 8 /  
 9. 9 /  
 10. 10 /  
 11. 11 /  
 12. 12 or more /  
 13. numerous <number, if countable> /
- #1353. pappus <of disk florets when in 1 whorl; pistillate heads; distinctive, general characters that serve to distinguish the taxon> /
- #1354. pappus <of disk florets when in 1 whorl; pistillate heads; persistence> /  
 1. caducous /  
 2. persistent in fruit /  
 3. not persistent in fruit /
- #1355. pappus <of disk florets when in 1 whorl; pistillate heads; fusion> /  
 1. free /  
 2. fused /  
 3. fused at bases /
- #1356. pappus <of disk florets when in 1 whorl; pistillate heads; aspect> /  
 1. appressed /  
 2. ascending /  
 3. spreading /  
 4. reflexed /  
 5. curled /
- #1357. pappus <of disk florets when in 1 whorl; pistillate heads; specific color or colors that serves to distinguish the taxon> /
- #1358. pappus <of disk florets when in 1 whorl; pistillate heads; nature> /  
 1. fragile /  
 2. stout /
- #1359. pappus <of disk florets when in 1 whorl; pistillate heads; nature> /  
 1. slender /  
 2. thick /  
 3. flattened on outer sides <e.g., Brickellia> /
- #1360. pappus <of disk florets when in 1 whorl; pistillate heads; width> /  
 mm wide /
- #1361. pappus <of disk florets when in 1 whorl; pistillate heads; equality in length> /  
 1. all equal in length /  
 2. unequal in length /
- #1362. pappus <of disk florets when in 1 whorl; pistillate heads; length> /  
 mm long /
- #1363. indumentum <of pappus of disk florets when in 1 whorl; pistillate heads> /  
 1. glabrous /  
 2. scabrous <rough to the touch with short, hard, rigid trichomes> /  
 3. scaberulous <minutely scabrous> /  
 4. pubescent <soft, short, dense trichomes> /  
 5. puberulent <minutely pubescent> /  
 6. velutinous <soft, short, dense, straight trichomes; velvety> /  
 7. tomentose <soft, short, dense, matted trichomes> /  
 8. villous <soft, long, dense, curly, ascending trichomes> /  
 9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky> /  
 10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly> /  
 11. pilose <soft, long, sparse, ascending, curly or straight trichomes> /  
 12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby> /  
 13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes> /  
 14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly> /  
 15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes> /  
 16. with glandular trichomes /  
 17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters> /  
 18. with barbed trichomes /

- #1364. apices <of pappus of disk florets when in 1 whorl;  
pistillate heads; shape>/  
1. rounded/  
2. obtuse/  
3. acute/  
4. acuminate/
- #1365. apices <of pappus of disk florets when in 1 whorl;  
pistillate heads>/  
1. with midribs excurrent as awns/  
2. with midribs not excurrent as awns/
- #1366. margins <of pappus of disk florets when in 1 whorl;  
pistillate heads>/  
1. entire/  
2. undulate/  
3. sinuate/  
4. crenate/  
5. crenulate/  
6. erose/  
7. serrate/  
8. doubly serrate/  
9. serrulate/  
10. dentate/  
11. denticulate/  
12. incised/  
13. lacerate/  
14. lacinate/  
15. crispate/  
16. ciliate/  
17. spinose/  
18. scariosus/  
19. membranous/
- #1367. bases <of pappus of disk florets when in 1 whorl;  
pistillate heads; nature>/  
1. wide/  
2. narrow/
- #1368. bases <of pappus of disk florets when in 1 whorl;  
pistillate heads; nature>/  
1. thick/  
2. thin/
- #1369. bases <of pappus of disk florets when in 1 whorl;  
pistillate heads; nature>/  
1. straight/  
2. curved/
- #1370. outer pappus <of disk florets when in 2 whorls;  
pistillate heads; morphological forms>/  
1. of awns/  
2. of scales/  
3. of teeth/  
4. of appressed teeth/  
5. of capillary hairs/  
6. of capillary bristles/  
7. of bristles/  
8. of scabrous bristles/  
9. of stiff bristles/  
10. of plumose bristles/  
11. coroniform/  
12. of barbellate bristles/  
13. of scarios scales/  
14. of smooth bristles/  
15. of hairs/  
16. an adaxial auricle <e.g., Anthemis>/  
17. of bristlelike scales/  
18. of stiff scales/  
19. of subclavate hairs/  
20. of subulate hairs <awl-shaped>/  
21. a crenulate rim <e.g., Heliopsis>/  
22. of barbellate awns/  
23. of retrorsely hispid awns/  
24. of fimbriate awns/  
25. of elongate awns/  
26. of serrulate awns/
- #1371. outer pappus <of disk florets when in 2 whorls;  
pistillate heads; number of parts>/  
1. 1/  
2. 2/  
3. 3/  
4. 4/  
5. 5/  
6. 6/  
7. 7/  
8. 8/  
9. 9/  
10. 10/  
11. 11/  
12. 12 or more/  
13. numerous <number, if countable>/
- #1372. outer pappus <of disk florets when in 2 whorls;  
pistillate heads; distinctive, general characters that serve  
to distinguish the taxon>/
- #1373. outer pappus <of disk florets when in 2 whorls;  
pistillate heads; persistence>/  
1. caducous/  
2. persistent in fruit/  
3. not persistent in fruit/
- #1374. outer pappus <of disk florets when in 2 whorls;  
pistillate heads; fusion>/  
1. free/  
2. fused/  
3. fused at bases/
- #1375. outer pappus <of disk florets when in 2 whorls;  
pistillate heads; aspect>/  
1. appressed/  
2. ascending/  
3. spreading/  
4. reflexed/  
5. curled/
- #1376. outer pappus <of disk florets when in 2 whorls;  
pistillate heads; specific color or colors that serves to  
distinguish the taxon>/
- #1377. outer pappus <of disk florets when in 2 whorls;  
pistillate heads; nature>/  
1. fragile/  
2. stout/
- #1378. outer pappus <of disk florets when in 2 whorls;  
pistillate heads; nature>/  
1. slender/  
2. thick/  
3. flattened on outer sides <e.g., Brickellia>/
- #1379. outer pappus <of disk florets when in 2 whorls;  
pistillate heads; width>/  
mm wide/
- #1380. outer pappus <of disk florets when in 2 whorls;  
pistillate heads; equality in length>/  
1. all equal in length/  
2. unequal in length/
- #1381. outer pappus <of disk florets when in 2 whorls;  
pistillate heads; length>/  
mm long/
- #1382. indumentum <of outer pappus of disk florets when in 2  
whorls; pistillate heads>/  
1. glabrous/  
2. scabrous <rough to the touch with short, hard, rigid  
trichomes>/  
3. scaberulous <minutely scabrous>/  
4. pubescent <soft, short, dense trichomes>/  
5. puberulent <minutely pubescent>/  
6. velutinous <soft, short, dense, straight trichomes;  
velvety>/  
7. tomentose <soft, short, dense, matted trichomes>/  
8. villous <soft, long, dense, curly, ascending trichomes>/  
9. sericeous <soft, long, dense or sparse, appressed,  
straight trichomes; silky>/  
10. lanate <soft, long, dense, matted, ascending, curly  
trichomes; woolly>/

11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/
  12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/
  13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/
  14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/
  15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/
  16. with glandular trichomes/
  17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/
  18. with barbed trichomes/
- #1383. apices <of outer pappus of disk florets when in 2 whorls; pistillate heads; shape>/
1. rounded/
  2. obtuse/
  3. acute/
  4. acuminate/
- #1384. apices <of outer pappus of disk florets when in 2 whorls; pistillate heads>/
1. with midribs excurrent as awns/
  2. midribs not excurrent as awns/
- #1385. margins <of outer pappus of disk florets when in 2 whorls; pistillate heads>/
1. entire/
  2. undulate/
  3. sinuate/
  4. crenate/
  5. crenulate/
  6. erose/
  7. serrate/
  8. doubly serrate/
  9. serrulate/
  10. dentate/
  11. denticulate/
  12. incised/
  13. lacerate/
  14. lacinate/
  15. crispate/
  16. ciliate/
  17. spinose/
  18. scarious/
  19. membranous/
- #1386. bases <of outer pappus of disk florets when in 2 whorls; pistillate heads; nature>/
1. wide/
  2. narrow/
- #1387. bases <of outer pappus of disk florets when in 2 whorls; pistillate heads; nature>/
1. thick/
  2. thin/
- #1388. bases <of outer pappus of disk florets when in 2 whorls; pistillate heads; nature>/
1. straight/
  2. curved/
- #1389. inner pappus <of disk florets when in 2 whorls; pistillate heads; morphological forms>/
1. of awns/
  2. of scales/
  3. of teeth/
  4. of appressed teeth/
  5. of capillary hairs/
  6. of capillary bristles/
  7. of bristles/
  8. of scabrous bristles/
  9. of stiff bristles/
  10. of plumose bristles/
  11. coroniform/
  12. of barbellate bristles/
  13. of scarious scales/
  14. of smooth bristles/
  15. of hairs/
16. an adaxial auricle <e.g., Anthemis>/
  17. of bristlelike scales/
  18. of stiff scales/
  19. of subclavate hairs/
  20. of subulate hairs <awl-shaped>/
  21. a crenulate rim <e.g., Heliopsis>/
  22. of barbellate awns/
  23. of retrorsely hispid awns/
  24. of fimbriate awns/
  25. of elongate awns/
  26. of serrulate awns/
- #1390. inner pappus <of disk florets when in 2 whorls; pistillate heads; number of parts>/
1. 1/
  2. 2/
  3. 3/
  4. 4/
  5. 5/
  6. 6/
  7. 7/
  8. 8/
  9. 9/
  10. 10/
  11. 11/
  12. 12 or more/
  13. numerous <number, if countable>/
- #1391. inner pappus <of disk florets when in 2 whorls; pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1392. inner pappus <of disk florets when in 2 whorls; pistillate heads; persistence>/
1. caducous/
  2. persistent in fruit/
  3. not persistent in fruit/
- #1393. inner pappus <of disk florets when in 2 whorls; pistillate heads; fusion>/
1. free/
  2. fused/
  3. fused at bases/
- #1394. inner pappus <of disk florets when in 2 whorls; pistillate heads; aspect>/
1. appressed/
  2. ascending/
  3. spreading/
  4. reflexed/
  5. curled/
- #1395. inner pappus <of disk florets when in 2 whorls; pistillate heads; specific color or colors that serves to distinguish the taxon>/
- #1396. inner pappus <of disk florets when in 2 whorls; pistillate heads; nature>/
1. fragile/
  2. stout/
- #1397. inner pappus <of disk florets when in 2 whorls; pistillate heads; nature>/
1. slender/
  2. thick/
  3. flattened on outer sides <e.g., Brickellia>/
- #1398. inner pappus <of disk florets when in 2 whorls; pistillate heads; width>/
- mm wide/
- #1399. inner pappus <of disk florets when in 2 whorls; pistillate heads; equality in length>/
1. all equal in length/
  2. unequal in length/
- #1400. inner pappus <of disk florets when in 2 whorls; pistillate heads; length>/
- mm long/

- #1401. indumentum <of inner pappus of disk florets when in 2 whorls; pistillate heads>/  
 1. glabrous/  
 2. scabrous <rough to the touch with short, hard, rigid trichomes>/  
 3. scaberulous <minutely scabrous>/  
 4. pubescent <soft, short, dense trichomes>/  
 5. puberulent <minutely pubescent>/  
 6. velutinous <soft, short, dense, straight trichomes; velvety>/  
 7. tomentose <soft, short, dense, matted trichomes>/  
 8. villous <soft, long, dense, curly, ascending trichomes>/  
 9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/  
 10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/  
 11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/  
 12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/  
 13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/  
 14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/  
 15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/  
 16. with glandular trichomes/  
 17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/  
 18. with barbed trichomes/
- #1402. apices <of inner pappus of disk florets when in 2 whorls; pistillate heads; shape>/  
 1. rounded/  
 2. obtuse/  
 3. acute/  
 4. acuminate/
- #1403. apices <of inner pappus of disk florets when in 2 whorls; pistillate heads>/  
 1. with midribs excurrent as awns/  
 2. with midribs not excurrent as awns/
- #1404. margins <of inner pappus of disk florets when in 2 whorls; pistillate heads>/  
 1. entire/  
 2. undulate/  
 3. sinuate/  
 4. crenate/  
 5. crenulate/  
 6. erose/  
 7. serrate/  
 8. doubly serrate/  
 9. serrulate/  
 10. dentate/  
 11. denticulate/  
 12. incised/  
 13. lacerate/  
 14. lacinate/  
 15. crispate/  
 16. ciliate/  
 17. spinose/  
 18. scarious/  
 19. membranous/
- #1405. bases <of inner pappus of disk florets when in 2 whorls; pistillate heads; nature>/  
 1. wide/  
 2. narrow/
- #1406. bases <of inner pappus of disk florets when in 2 whorls; pistillate heads; nature>/  
 1. thick/  
 2. thin/
- #1407. bases <of inner pappus of disk florets when in 2 whorls; pistillate heads; nature>/  
 1. straight/  
 2. curved/
- #1408. corollas <of disk florets of pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1409. corollas <of disk florets of pistillate heads; fusion of lobes>/  
 1. 4-lobed/  
 2. 5-lobed/  
 3. shallowly 5-lobed/  
 4. deeply 5-lobed/
- #1410. corollas <of disk florets of pistillate heads; persistence>/  
 1. cauducous/  
 2. persistent at maturity/  
 3. deciduous at maturity/
- #1411. corollas <of disk florets of pistillate heads; specific color or colors that serves to distinguish the taxon>/
- #1412. corollas <of disk florets of pistillate heads; texture>/  
 1. membranous/  
 2. fleshy/  
 3. succulent/  
 4. cartilaginous <hard and tough, but flexible>/  
 5. chartaceous <papery, opaque and thin, e.g., Hymenoxys>/  
 6. coriaceous <leathery>/  
 7. flaccid <lax and weak>/  
 8. herbaceous <soft and succulent>/  
 9. hyaline <thin and translucent or transparent>/  
 10. indurate <hardened>/  
 11. scarious <thin and dry>/
- #1413. corollas <of disk florets of pistillate heads; shape>/  
 1. campanulate/  
 2. salverform/  
 3. funnelform/  
 4. tubular/  
 5. urceolate/
- #1414. corollas <of disk florets of pistillate heads; width>/  
 mm wide/
- #1415. corollas <of disk florets of pistillate heads; length>/  
 mm long/
- #1416. indumentum <of corollas of disk florets; pistillate heads>/  
 1. glabrous/  
 2. scabrous <rough to the touch with short, hard, rigid trichomes>/  
 3. scaberulous <minutely scabrous>/  
 4. pubescent <soft, short, dense trichomes>/  
 5. puberulent <minutely pubescent>/  
 6. velutinous <soft, short, dense, straight trichomes; velvety>/  
 7. tomentose <soft, short, dense, matted trichomes>/  
 8. villous <soft, long, dense, curly, ascending trichomes>/  
 9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/  
 10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/  
 11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/  
 12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/  
 13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/  
 14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/  
 15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/  
 16. with glandular trichomes/  
 17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/  
 18. with barbed trichomes/
- #1417. indumentation <of corollas of disk florets; pistillate heads; description of indumentation and location that serves to distinguish the taxon>/

- #1418. lobes <of corollas of disk florets; pistillate heads; aspect>/  
 1. erect/  
 2. ascending/  
 3. spreading/  
 4. reflexed/  
 5. curled/
- #1419. apices <of corolla lobes of disk florets; pistillate heads; shape>/  
 1. rounded/  
 2. obtuse/  
 3. acute/  
 4. acuminate/
- #1420. bases of corolla tubes <of disk florets of pistillate heads; enlargement>/  
 1. not enlarged in fruit <implicit>/  
 2. slightly saccate in fruit <e.g., Achillea>/  
 3. swollen in fruit/
- #1421. stamens <of disk florets of pistillate heads; presence>/  
 1. present/  
 2. absent/
- #1422. stamens <of disk florets of pistillate heads; number>/  
 1. 3/  
 2. 4/  
 3. 5/
- #1423. stamens <of disk florets of pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1424. stamens <of disk florets of pistillate heads; length>/  
 mm long/
- #1425. stamens <of disk florets of pistillate heads; fusion>/  
 1. free/  
 2. fused by filaments/  
 3. fused by anthers <implicit>/
- #1426. anthers <of disk florets of pistillate heads; distinctive, general characteristics that serve to distinguish the taxon>/
- #1427. anthers <of disk florets of pistillate heads; specific color or colors that serves to distinguish the taxon>/
- #1428. anthers <of disk florets of pistillate heads; straightness>/  
 1. straight/  
 2. curved/
- #1429. anthers <of disk florets of pistillate heads; width>/  
 mm wide/
- #1430. anthers <of disk florets of pistillate heads; length>/  
 mm long/
- #1431. apical appendages <of anthers of disk florets; pistillate heads; presence>/  
 1. present/  
 2. absent/
- #1432. apical appendages <of anthers of disk florets; pistillate heads; appearance>/  
 1. flat/  
 2. keeled/  
 3. curved/
- #1433. apical appendages <of anthers of disk florets; pistillate heads; shape>/  
 1. linear/  
 2. lanceolate/  
 3. subulate/  
 4. spatulate/
- #1434. apical appendages <of anthers of disk florets; pistillate heads; width>/  
 mm wide/
- #1435. apical appendages <of anthers of disk florets; pistillate heads; length>/  
 mm long/
- #1436. thecae <of anthers of disk florets; pistillate heads; distinctive, general characteristics that serve to distinguish the taxon>/
- #1437. bases <of anthers of disk florets; pistillate heads; shape>/  
 1. obtuse/  
 2. subtruncate/  
 3. rounded/  
 4. sagittate/  
 5. caudate <tailed>/
- #1438. connective tissue <of anthers of disk florets; pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1439. pollen <of disk florets of pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1440. filaments <of disk florets of pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1441. styles <of disk florets of pistillate heads; presence>/  
 1. present <implicit>/  
 2. absent/
- #1442. styles <of disk florets of pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1443. styles <of disk florets of pistillate heads; division>/  
 1. divided/  
 2. not divided/
- #1444. styles <of disk florets of pistillate heads; describe degree of division if serves to distinguish the taxon>/
- #1445. styles <of disk florets of pistillate heads; length>/  
 mm long/
- #1446. styles <of disk florets of pistillate heads; length relative to corolla tubes>/  
 1. exerted beyond corolla tubes/  
 2. included within corolla tubes/  
 3. equalling corolla tubes/
- #1447. style branches <of disk florets of pistillate heads; presence>/  
 1. present/  
 2. absent/
- #1448. style branches <of disk florets of pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1449. style branches <of disk florets of pistillate heads; lobing>/  
 1. not lobed/  
 2. 2-lobed/
- #1450. style branches <of disk florets of pistillate heads; color or colors that serves to distinguish the taxon>/
- #1451. style branches <of disk florets of pistillate heads; shape>/  
 1. linear/  
 2. clavate/  
 3. filiform/  
 4. lanceolate/
- #1452. style branches <of disk florets of pistillate heads; organization of stigmatic regions>/  
 1. stigmatic regions on adaxial surfaces/  
 2. stigmatic regions forming 2 marginal bands/
- #1453. indumentum <of style branches of disk florets; pistillate heads>/  
 1. glabrous/



2. scabrous <rough to the touch with short, hard, rigid trichomes>/
3. scaberulous <minutely scabrous>/
4. pubescent <soft, short, dense trichomes>/
5. puberulent <minutely pubescent>/
6. velutinous <soft, short, dense, straight trichomes; velvety>/
7. tomentose <soft, short, dense, matted trichomes>/
8. villous <soft, long, dense, curly, ascending trichomes>/
9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/
10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/
11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/
12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/
13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/
14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/
15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/
16. with glandular trichomes/
17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/
18. with barbed trichomes/
- #1454. sterile appendages <of style branches of disk florets; pistillate heads; presence>/
1. present/
2. absent/
- #1455. apices <of style branches of disk florets; pistillate heads; shape>/
1. attenuate/
2. rounded/
3. truncate/
4. obtuse/
5. acute/
6. acuminate/
7. triangular/
- #1456. bases <of styles of disk florets; pistillate heads; nature>/
1. swollen/
2. not swollen/
3. not swollen but with shaft enlarged/
- #1457. bases <of styles of disk florets; pistillate heads; nectaries>/
1. nectaries present/
2. nectaries absent/
- #1458. indumentum <of bases of styles of disk florets; pistillate heads>/
1. glabrous/
2. scabrous <rough to the touch with short, hard, rigid trichomes>/
3. scaberulous <minutely scabrous>/
4. pubescent <soft, short, dense trichomes>/
5. puberulent <minutely pubescent>/
6. velutinous <soft, short, dense, straight trichomes; velvety>/
7. tomentose <soft, short, dense, matted trichomes>/
8. villous <soft, long, dense, curly, ascending trichomes>/
9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/
10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/
11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/
12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/
13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/
14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/
15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/
16. with glandular trichomes/
17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/
18. with barbed trichomes/
- #1459. sweeping hairs <on styles and style branches of disk florets; pistillate heads; presence>/
1. present/
2. absent/
- #1460. sweeping hairs <on styles and style branches of disk florets; pistillate heads; arrangement>/
1. scattered abaxially along style branches and extending down shafts of styles <e.g., Vernonia>/
2. in ring on shafts below style branches <e.g., Cardus>/
3. concentrated on tips of style branches/
4. forming terminal truncate brushes on style branches <e.g., Senecio>/
- #1461. sweeping hairs <on styles and style branches of disk florets; pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1462. achenes <of disk florets of pistillate heads; presence>/
1. present/
2. absent/
- #1463. achenes <of disk florets of pistillate heads; distinctiveness>/
1. vestigial/
2. developed/
- #1464. achenes <of disk florets of pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1465. achenes <of disk florets of pistillate heads; color or colors that serves to distinguish the taxon>/
- #1466. achenes <of disk florets of pistillate heads; surface>/
1. smooth/
2. glandular/
3. spiny/
4. rugulose/
5. setose <covered with bristles>/
6. muricate/
7. tuberculate/
8. undulating/
9. rugose/
10. sulcate/
11. striate/
- #1467. achenes <of disk florets of pistillate heads; shape in cross-section>/
1. angular/
2. terete/
3. trigonous/
4. tetragonous/
5. pentagonous/
6. flattened/
7. lenticular/
- #1468. achenes <of disk florets of pistillate heads; shape in longitudinal-section>/
1. columnar/
2. conical/
3. fusiform/
4. ovate/
5. oblong/
6. obconical/
7. elliptic/
8. obovate/
9. oblanceolate/
10. lanceolate/
11. linear/
12. clavate/
13. cylindrical/
- #1469. achenes <of disk florets of pistillate heads; width>/
- mm wide/
- #1470. achenes <of disk florets of pistillate heads; length>/
- mm long/

- #1471. indumentum <of achenes of disk florets; pistillate heads>/  
 1. glabrous/  
 2. scabrous <rough to the touch with short, hard, rigid trichomes>/  
 3. scaberulous <minutely scabrous>/  
 4. pubescent <soft, short, dense trichomes>/  
 5. puberulent <minutely pubescent>/  
 6. velutinous <soft, short, dense, straight trichomes; velvety>/  
 7. tomentose <soft, short, dense, matted trichomes>/  
 8. villous <soft, long, dense, curly, ascending trichomes>/  
 9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/  
 10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/  
 11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/  
 12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/  
 13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/  
 14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/  
 15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/  
 16. with glandular trichomes/  
 17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/  
 18. with barbed trichomes/
- #1472. indumentum <of achenes of disk florets; pistillate heads; location; descriptors for location of hairs that serve to characterize the taxon>/
- #1473. ribs <of achenes of disk florets; pistillate heads; presence>/  
 1. present/  
 2. absent/
- #1474. ribs <of achenes of disk florets; pistillate heads; number>/  
 1. 1/  
 2. 2/  
 3. 3/  
 4. 4/  
 5. 5/  
 6. 6/  
 7. 7/  
 8. 8/  
 9. 9/  
 10. 10/  
 11. 12 or more/
- #1475. ribs <of achenes of disk florets; pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1476. ribs <of achenes of disk florets; pistillate heads; conspicuousness>/  
 1. conspicuous/  
 2. inconspicuous/
- #1477. wings <of achenes of disk florets; pistillate heads; presence>/  
 1. present/  
 2. absent/
- #1478. wings <of achenes of disk florets; pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1479. wings <of achenes of disk florets; pistillate heads; position>/  
 1. continuous from apices to bases/  
 2. primarily apical/  
 3. primarily basal/
- #1480. beaks <of achenes of disk florets; pistillate heads; presence>/  
 1. present/
2. absent/
- #1481. beaks <of achenes of disk florets; pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1482. beaks <of achenes of disk florets; pistillate heads; curvature>/  
 1. curved/  
 2. not curved/
- #1483. beaks <of achenes of disk florets; pistillate heads; specific color or colors that serves to distinguish the taxon>/
- #1484. beaks <of achenes of disk florets; pistillate heads; length>/  
 mm long/
- #1485. bases <of achenes of disk florets; pistillate heads; attachment>/  
 1. attached to subtending receptacular bracts/  
 2. not attached to subtending receptacular bracts/
- #1486. receptacles <of pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1487. receptacles <of pistillate heads; shape>/  
 1. flat/  
 2. cylindrical/  
 3. concave/  
 4. convex/  
 5. conical/  
 6. globose/  
 7. elongate/  
 8. subulate/  
 9. hemispheric/  
 10. subglobose/
- #1488. receptacles <of pistillate heads; density>/  
 1. solid/  
 2. spongy/  
 3. hollow <e.g., Heliopsis>/
- #1489. surfaces <of receptacles of pistillate heads; appearance>/  
 1. smooth/  
 2. pitted <or alveolate>/
- #1490. surfaces <of receptacle of pistillate heads; indumentum>/  
 1. glabrous/  
 2. indumented <describe if distinctive>/  
 3. setose <bristly>/
- #1491. receptacular bracts <of pistillate heads; presence>/  
 1. present/  
 2. absent/
- #1492. receptacular bracts <of pistillate heads; persistence>/  
 1. persistent/  
 2. deciduous/
- #1493. receptacular bracts <of pistillate heads; distinctive, general characters that serve to distinguish the taxon>/
- #1494. receptacular bracts <of pistillate heads; color or colors that serves to distinguish the taxon>/
- #1495. receptacular bracts <of pistillate heads; shape>/  
 1. linear/  
 2. lanceolate/  
 3. oblanceolate/  
 4. elliptic/  
 5. ovate/  
 6. obovate/  
 7. oblong/
- #1496. receptacular bracts <of pistillate heads; appearance>/  
 1. angular/  
 2. rounded/

3. flat/
- #1497. receptacular bracts <of pistillate heads; nature>/  
1. straight/  
2. curved/
- #1498. receptacular bracts <of pistillate heads; keels>/  
1. keeled/  
2. not keeled/
- #1499. receptacular bracts <of pistillate heads; width>/  
mm wide/
- #1500. receptacular bracts <of pistillate heads; length>/  
1. longer than disk florets <e.g., Silphium, Echinacea>/  
2. shorter than disk florets/
- #1501. receptacular bracts <of pistillate heads; length>/  
mm long/
- #1502. indumentum <of pistillate heads; of receptacular bracts>/  
1. glabrous/  
2. scabrous <rough to the touch with short, hard, rigid trichomes>/  
3. scaberulous <minutely scabrous>/  
4. pubescent <soft, short, dense trichomes>/  
5. puberulent <minutely pubescent>/  
6. velutinous <soft, short, dense, straight trichomes; velvety>/  
7. tomentose <soft, short, dense, matted trichomes>/  
8. villous <soft, long, dense, curly, ascending trichomes>/  
9. sericeous <soft, long, dense or sparse, appressed, straight trichomes; silky>/  
10. lanate <soft, long, dense, matted, ascending, curly trichomes; woolly>/  
11. pilose <soft, long, sparse, ascending, curly or straight trichomes>/  
12. arachnoid <soft, very long, dense, thin, loosely entangled trichomes; cobwebby>/  
13. hirsute <stiff, long, dense or sparse, erect or ascending, straight trichomes>/  
14. hispid <stiff, long, tapered, dense or sparse, erect or ascending, straight trichomes; bristly>/  
15. strigose <stiff, long, sharp, bulbous base, dense or sparse, appressed, straight or curved trichomes>/  
16. with glandular trichomes/  
17. stellate <trichomes with branches radiating from base or separate hairs aggregated into star-like clusters>/  
18. with barbed trichomes/
- #1503. apices <of receptacular bracts of pistillate heads; shape>/  
1. truncate/  
2. acute/  
3. acuminate/  
4. rounded/  
5. obtuse/
- #1504. apices <of receptacular bracts of pistillate heads>/  
1. with midribs excurrent as awns/  
2. with midribs not excurrent as awns/
- #1505. margins <of receptacular bracts of pistillate heads>/  
1. entire/  
2. undulate/  
3. sinuate/  
4. crenate/  
5. crenulate/  
6. erose/  
7. serrate/  
8. doubly serrate/  
9. serrulate/  
10. dentate/  
11. denticulate/  
12. incised/  
13. lacerate/  
14. laciniate/  
15. crispate/  
16. ciliate/  
17. spinose/
18. scarious/  
19. membranous/
- #1506. bases <of receptacular bracts of pistillate heads; nature>/  
1. wide/  
2. narrow/
- #1507. bases <of receptacular bracts of pistillate heads; nature>/  
1. thick/  
2. thin/
- #1508. bases <of receptacular bracts of pistillate heads; nature>/  
1. straight/  
2. curved/
- #1509. <complete sentences giving numbers of species, subspecies, varieties, or forms present in Oklahoma>/
- #1510. <complete sentences describing important taxonomic aspects such as problems in identification, classification, and/or nomenclature>/
- #1511. <complete sentences describing important or characteristic aspects of genera or species such as ecological and/or geographical distribution; economic significance; region of origin if adventive, introduced, or naturalized; reproductive biology>/

## APPENDIX B

### DELTA-SPECS

\*SHOW: Asteraceae of Oklahoma - specifications. Revised 25 January 1997.

\*NUMBER OF CHARACTERS 1511

\*MAXIMUM NUMBER OF STATES 35

\*MAXIMUM NUMBER OF ITEMS 200

\*CHARACTER TYPES 2,RN 3,TE 9-10,RN 12,TE 13,RN 15,TE 16,RN 21,TE 26,TE 29-30,RN 34,TE 37-38,TE 40,TE 42,TE 47,TE 52,TE 55-56,RN 60,TE 63-64,TE 66,TE 68,TE 72,TE 77,TE 80-81,RN 85,TE 88-89,TE 91,TE 93,TE 98,TE 103,TE 106-107,RN 111,TE 114-115,TE 117,TE 119,TE 123,TE 128,TE 131-132,RN 136,TE 139-140,TE 142,TE 144,TE 150,TE 152,RN 158,TE 162,TE 165,RN 167,RN 177,TE 181,TE 184,RN 186,RN 196,TE 200,TE 203,RN 205,RN 213,TE 218,TE 221-222,RN 225,TE 230,TE 231,RN 233-234,TE 236-237,RN 241-242,RN 243,TE 245-247,TE 249,TE 251,TE 252,RN 255,TE 257,TE 268,TE 271-272,TE 276-277,RN 279,TE 282,TE 285,TE 288,TE 290,TE 291,RN 295,TE 301,TE 305,TE 308,RN 310,RN 320,TE 324,TE 327,RN 329,RN 339,TE 343,TE 346,RN 348,RN 356,TE 359,TE 362-363,RN 365,TE 371,TE 372,RN 374-375,TE 377-378,RN 382-383,RN 384,TE 386-388,TE 390,TE 392,TE 393,RN 396,TE 398,TE 409,TE 412-413,TE 417-418,RN 420,TE 423,TE 426,TE 429,TE 431,TE 432,RN 436,TE 442,TE 446,TE 449,RN 451,RN 461,TE 465,TE 468,RN 470,RN 480,TE 484,TE 487,RN 489,RN 497,TE 501,TE 504-505,RN 508,TE 513,TE 514,RN 516-517,TE 519-520,RN 524-525,RN 526,TE 528-530,TE 532,TE 534,TE 535,RN 538,TE 540,TE 551,TE 554-555,TE 559-560,RN 562,TE 565,TE 568,TE 571,TE 573,TE 574,RN 576,TE 583-584,TE 589,RN 591,RN 599,RN 600,TE 606-607,RN 609,TE 610,RN 612,TE 613,RN 618,TE 623,TE 626-627,RN 631,TE 634-635,TE 637,TE 639,TE 644,TE 649,TE 652-653,RN 657,TE 660-661,TE 663,TE 665,TE 669,TE 674,TE 677-678,RN 682,TE 685-686,TE 688,TE 690,TE 695,TE 700,TE 703-704,RN 708,TE 711-712,TE 714,TE 716,TE 720,TE 725,TE 728-729,RN 733,TE 736-737,TE 739,TE 741,TE 747,TE 749,RN 755,TE 759,TE 762,RN 764,RN 774,TE 778,TE 781,RN 783,RN 793,TE 797,TE 800,RN 802,RN 810,TE 815,TE 818-819,RN 822,TE 827,TE 828,RN 830-831,TE 833-834,RN 838-839,RN 840,TE 842-844,TE 846,TE 848,TE 849,RN 852,TE 854,TE 865,TE 868-869,TE 873-874,RN 876,TE 879,TE 882,TE 885,TE 887,TE 888,RN 892,TE 898,TE

902,TE 905,RN 907,RN 917,TE 921,TE 924,RN 926,RN 936,TE 940,TE 943,RN 945,RN 953,TE 956,TE 959-960,RN 962,RN 968,TE 969,RN 971-972,TE 974-975,RN 979-980,RN 981,TE 983-985,TE 987,TE 989,TE 990,RN 993,TE 995,TE 1006,TE 1009-1010,TE 1014-1015,RN 1017,TE 1020,TE 1023,TE 1026,TE 1028,TE 1029,RN 1031,TE 1038-1039,TE 1044,RN 1046,RN 1054,RN 1055,TE 1061-1062,RN 1064,TE 1065,RN 1067,TE 1068,RN 1073,TE 1078,TE 1081-1082,RN 1086,TE 1089-1090,TE 1092,TE 1094,TE 1099,TE 1104,TE 1107-1108,RN 1112,TE 1115-1116,TE 1118,TE 1120,TE 1124,TE 1129,TE 1132-1133,RN 1137,TE 1140-1141,TE 1143,TE 1145,TE 1150,TE 1155,TE 1158-1159,RN 1163,TE 1166-1167,TE 1169,TE 1171,TE 1175,TE 1180,TE 1183-1184,RN 1188,TE 1191-1192,TE 1194,TE 1196,TE 1202,TE 1204,RN 1210,TE 1214,TE 1217,RN 1219,RN 1229,TE 1233,TE 1236,RN 1238,RN 1248,TE 1252,TE 1255,RN 1257,RN 1265,TE 1270,TE 1273-1274,RN 1277,TE 1282,TE 1283,RN 1285-1286,TE 1288-1289,RN 1293-1294,RN 1295,TE 1297-1299,TE 1301,TE 1303,TE 1304,RN 1307,TE 1309,TE 1320,TE 1323-1324,TE 1328-1329,RN 1331,TE 1334,TE 1337,TE 1340,TE 1342,TE 1343,RN 1347,TE 1353,TE 1357,TE 1360,RN 1362,RN 1372,TE 1376,TE 1379,RN 1381,RN 1391,TE 1395,TE 1398,RN 1400,RN 1408,TE 1411,TE 1414-1415,RN 1417,TE 1423,TE 1424,RN 1426-1427,TE 1429-1430,RN 1434-1435,RN 1436,TE 1438-1440,TE 1442,TE 1444,TE 1445,RN 1448,TE 1450,TE 1461,TE 1464-1465,TE 1469-1470,RN 1472,TE 1475,TE 1478,TE 1481,TE 1483,TE 1484,RN 1486,TE 1493-1494,TE 1499,RN 1501,RN 1509-1511,TE

\*NUMBERS OF STATES 1,3 4,12 6,4 8,4 18,4 19,13 20,7 22,3 24,5 25,6 27,15 28,25 31,20 32,3 33,4 35,18 36,17 39,3 41,19 46,13 48,3 50,3 51,6 53,15 54,25 57,20 58,3 59,4 61,18 62,17 65,3 67,19 71,13 73,3 75,3 76,6 78,15 79,25 82,20 83,3 84,4 86,18 87,17 90,3 92,19 97,13 99,3 101,3 102,6 104,15 105,25 108,20 109,3 110,4 112,18 113,17 116,3 118,19 122,13 124,3 126,3 127,6 129,15 130,25 133,20 134,3 135,4 137,18 138,17 141,3 143,19 149,10 151,3 153,6 155,3 156,26 157,13 159-160,3 161,5 164,3 168,18 169,4 171,19 175,26 176,13 178-179,3 180,5 183,3 187,18 188,4 190,19 194,26 195,13 197-198,3 199,5 202,3 206,18 207,4 209,19 214,3 215,6 216,3 217,5 219,11 220,14 223,4 224,18 226,4 227,3 229,3 232,3 239,3 240,4 244,5 253,3 258,4 260,18 262,7 263,3 265,18 267,4 273,11 274,7 275,13 278,18 281,11 286,3 294,10 296,6 298,3 299,26 300,13 302-303,3 304,5 307,3 311,18 312,4 314,19 318,26 319,13 321-322,3 323,5 326,3 330,18 331,4 333,19 337,26 338,13 340-341,3 342,5 345,3 349,18 350,4 352,19 357,4 358,3 360,11 361,5 364,18 366,5 367,4 368,3 370,3 373,3 380,3 381,4 385,5 394,3 399,4 401,18 403,7 404,3 406,18 408,4 414,11 415,7 416,13 419,18 422,11 427,3 435,10 437,6 439,3 440,26 441,13 443-444,3 445,5 448,3 452,18 453,4 455,19 459,26 460,13 462-463,3 464,5 467,3 471,18 472,4 474,19 478,26 479,13 481-482,3 483,5 486,3 490,18 491,4 493,19 499,3 500,5 502,11 503,14 507,18 509,4 510,3 512,3 515,3 522,3 523,4 527,5 536,3 541,4 543,18 545,7 546,3 548,18 550,4 556,11 557,7 558,13 561,18 564,11 569,3 577,10 578,3 580,3 585,7 586,3 592,18 593,5 595,19 601,12 603,4 605,4 615,4 616,13 617,7 619,3 621,5 622,6 624,15 625,25 628,20 629,3 630,4 632,18 633,17

636,3 638,19 643,13 645,3 647,3 648,6 650,15 651,25 654,20 655,3 656,4 658,18  
 659,17 662,3 664,19 668,13 670,3 672,3 673,6 675,15 676,25 679,20 680,3 681,4  
 683,18 684,17 687,3 689,19 694,13 696,3 698,3 699,6 701,15 702,25 705,20  
 706,3 707,4 709,18 710,17 713,3 715,19 719,13 721,3 723,3 724,6 726,15 727,25  
 730,20 731,3 732,4 734,18 735,17 738,3 740,19 746,10 748,3 750,6 752,3 753,26  
 754,13 756-757,3 758,5 761,3 765,18 766,4 768,19 772,26 773,13 775-776,3  
 777,5 780,3 784,18 785,4 787,19 791,26 792,13 794-795,3 796,5 799,3 803,18  
 804,4 806,19 811,3 812,6 813,3 814,5 816,11 817,14 820,4 821,18 823,4 824,3  
 826,3 829,3 836,3 837,4 841,5 850,3 855,4 857,18 859,7 860,3 862,18 864,4  
 870,11 871,7 872,13 875,18 878,11 883,3 891,10 893,6 895,3 896,26 897,13 899-  
 900,3 901,5 904,3 908,18 909,4 911,19 915,26 916,13 918-919,3 920,5 923,3  
 927,18 928,4 930,19 934,26 935,13 937-938,3 939,5 942,3 946,18 947,4 949,19  
 954,4 955,3 957,11 958,5 961,18 963,5 964,4 965,3 967,3 970,3 977,3 978,4  
 982,5 991,3 996,4 998,18 1000,7 1001,3 1003,18 1005,4 1011,11 1012,7 1013,13  
 1016,18 1019,11 1024,3 1032,10 1033,3 1035,3 1040,7 1041,3 1047,18 1048,5  
 1050,19 1056,12 1058,4 1060,4 1070,4 1071,13 1072,7 1074,3 1076,5 1077,6  
 1079,15 1080,25 1083,20 1084,3 1085,4 1087,18 1088,17 1091,3 1093,19  
 1098,13 1100,3 1102,3 1103,6 1105,15 1106,25 1109,20 1110,3 1111,4 1113,18  
 1114,17 1117,3 1119,19 1123,13 1125,3 1127,3 1128,6 1130,15 1131,25 1134,20  
 1135,3 1136,4 1138,18 1139,17 1142,3 1144,19 1149,13 1151,3 1153,3 1154,6  
 1156,15 1157,25 1160,20 1161,3 1162,4 1164,18 1165,17 1168,3 1170,19  
 1174,13 1176,3 1178,3 1179,6 1181,15 1182,25 1185,20 1186,3 1187,4 1189,18  
 1190,17 1193,3 1195,19 1201,10 1203,3 1205,6 1207,3 1208,26 1209,13 1211-  
 1212,3 1213,5 1216,3 1220,18 1221,4 1223,19 1227,26 1228,13 1230-1231,3  
 1232,5 1235,3 1239,18 1240,4 1242,19 1246,26 1247,13 1249-1250,3 1251,5  
 1254,3 1258,18 1259,4 1261,19 1266,3 1267,6 1268,3 1269,5 1271,11 1272,14  
 1275,4 1276,18 1278,4 1279,3 1281,3 1284,3 1291,3 1292,4 1296,5 1305,3  
 1310,4 1312,18 1314,7 1315,3 1317,18 1319,4 1325,11 1326,7 1327,13 1330,18  
 1333,11 1338,3 1346,10 1348,6 1350,3 1351,26 1352,13 1354-1355,3 1356,5  
 1359,3 1363,18 1364,4 1366,19 1370,26 1371,13 1373-1374,3 1375,5 1378,3  
 1382,18 1 1409,4 1410,3 1412,11 1413,5 1416,18 1418,5 1419,4 1420,3 1422,3  
 1425,3 1432,3 1433,4 1437,5 1446,3 1451,4 1453,18 1455,7 1456,3 1458,18  
 1460,4 1466,11 1467,7 1468,13 1471,18 1474,11 1479,3 1487,10 1488,3 1490,3  
 1495,7 1496,3 1502,18 1503,5 1505,19

\*IMPLICIT VALUES

\*DEPENDENT CHARACTERS

\*MANDATORY CHARACTERS

## APPENDIX C

### DELTA-ITEMS

\*SHOW: Asteraceae of Oklahoma - items. Revised 25 January 1997.

#### \*ITEM DESCRIPTIONS

# *Achillea millefolium* <L. Yarrow> / 1,1 2,300<or more> 4,9 5,1 6,1 8,3 9,3-4.5 10,4-5 13,4-7 14,1 16,3 18,1 19,12 20,3 49,1 50,1 51,1 53,12 54,5 55,0.5-0.75 56,1.5-2.5 57,9 58,1 59,3 60<midnerve stramineous to green> 61,7 62,15 66<stramineous to white> 67,16 74,1 75,1 76,1 78,12 79,5 80,1-1.15 81,2.5-3 82,9 83,1 84,3 85<midnerve stramineous to green> 86,7 87,15 91<stramineous to white> 92,19 96,2 148,1 149,3 151,1 153,2 154,1 155,1 215,4 216,2 217,4 218<white to pink> 219,1 220,14 221,2-2.5 222,3-3.5 223,3 224,1 226,1 227,2 252,1.25 256,1 257<rust or reddish brown> 258,2 259,2 260,1 261,1 262,3 263,2 264,1 265,1 266,2 269,1 270,2 272<golden brown to brown> 273,1 274,1&6 275,11&7<to> 276,0.4-0.5 277,1.25 278,1 280,2 284,1 286,1 287,2 292,2 293,1 294,10 296,1 297,1 298,1 357,2 358,2 359<white to pink> 360,1 361,4 362,0.6 363,2.25 364,1 366,4 367,3 368,2 369,1 372,4.5 375<stramineous to yellow> 376,1 377,0.2 378,1.25 379,1 380,3 381,4 382,0.2 383,0.2-0.3 385,3 388<flattened, glabrous> 393,1-2 395,1 397,1 398<rust to reddish brown> 399,2 400,2 401,1 402,2 403,3 404,2 405,1 406,1 407,2 410,1 411,2 413<golden brown to brown> 414,1 415,1&6 416,11&7<to> 417,0.4 418,1.5 419,1 421,2 425,1 427,1 428,2 433,2 577,5 578,1 579,2 580,1 581,1 583<similar in appearance to phyllaries> 584<stramineous green, midribs green and margins stramineous> 585,2 588,1 589,1.5 590,2 591,3.5 592,7 593,2 594,2 595,19 598,2 1509<One species of *Achillea*, *A. millefolium* L., is found within the state.> 1510<Classified in the subfamily Asteroideae and the tribe Anthemideae. It is known commonly as yarrow, milfoil, and nosebleed.> 1511<*Achillea* is widespread in grasslands and open woods and is frequently found in disturbed soils. It flowers in spring and early summer in our area. It is native of north temperate areas in Asia, Europe, and North America.>

# *Ambrosia trifida* <Torr. Ragweed> / 1,2 599,300<or more> 601,6 602,1 603,4 605,2 606,3.5 607,2 610,6.5<mm> 611,1 613,2 615,1 616,1&3<few, can't really tell, all fused together> 617,1 618<appearing as 1 united phyllary; shallowly or obscurely lobed> 621,2 622,3 623<green> 624,11

625,21 626,3.25-3.5<in diameter> 627,1.5-2<from center to edge> 629,3  
 630,3 631<dark, thickened vein-like strips extending from center to  
 margins, located on one side of the phyllaries> 632,13<with pustulate  
 bases, located among veins> 634<shallowly or obscurely lobed> 745,2  
 890,1 891,10 893,3 894,2 895,1 954,2 955,2 956<stramineous to yellow,  
 veins dark> 957,1 958,3 959,0.75-1 960,1.5 961,1 963,5<inward> 964,3 967,3  
 969,1.5 970,3 972<white to yellow> 973,1 976,1 977,3 978,3 982,3 986,1  
 988,1 990,0.75 991,2 1004,1 1005,3 1007,2 1032,1 1033,3 1036,1&2<or>  
 1038<slender and fimbriate-hairy or absent> 1039<white> 1045,2  
 1054,50-300<or more> 1055<subtend staminate heads> 1056,1&2<or>  
 1057,2 1058,1 1059,2 1061,3.5-4.5 1062,5-7 1063,2 1066,2 1067<sessile in  
 axils of bracts or rudimentary leaves below staminate flowers> 1069,1  
 1073<reticulate with 4 to 8 prominent ridges each ending in small  
 tubercles or short, blunt spines> 1076,4 1078<stramineous to green  
 with irregular purple spots> 1079,10 1084,1 1087,14<tuberculate bases>  
 1088,17 1089<apices terminating in short spines encircling a stout, conic  
 beak (1 mm)> 1345,1 1347<one floret per head> 1348,2 1349,1 1350,1  
 1408<absent> 1421,2 1441,1 1443,1 1444<for most of their length> 1447,1  
 1449,1 1451,1 1452,1 1453,1 1454,2 1455,2 1459,2 1462,1 1463,2  
 1464<enclosed within indurate burs formed by the fused phyllaries>  
 1465<rust to black> 1466,1 1467,7 1468,8&7<to> 1469,1.75-2.75 1470,3.5-4.5  
 1471,1 1473,2 1477,2 1480,2<one is present as part of the fused phyllaries  
 not as part of the achene> 1486<not present> 1491,2 1509<One variety is  
 recognized in our area, *Ambrosia trifida* var. *texana* Scheele.> 1510<It  
 is classified in the subfamily Asteroideae and the tribe Heliantheae.>  
 1511<*Ambrosia* is considered a weed and can be found throughout the  
 midwest and central United States. It is widespread and frequently  
 found in moist disturbed sites. Flowering occurs in late summer and  
 fall and is  
 considered to be a major contributor to hayfever in our area.>



## APPENDIX D

### DELTA-TONAT

\*SHOW: Translate into natural language  
\*HEADING: Asteraceae of Oklahoma  
\*LISTING FILE TONAT.LST  
\*PRINT FILE TONAT.PRT  
\*DATA BUFFER SIZE 6000  
\*INPUT FILE SPECS

\*SPECIAL STORAGE

\*TRANSLATE INTO NATURAL LANGUAGE  
\*OMIT TYPSETTING MARKS  
\*REPLACE ANGLE BRACKETS  
\*OMIT CHARACTER NUMBERS  
\*OMIT INAPPLICABLES

\*ITEM SUBHEADINGS

\*LINK CHARACTERS 1-10 11-13 14-16 17-31 32-34 36-37 38-41 42-45  
46-57 58-60 62-63 64-67 68-70 71-82 83-85 87-88 89-92 93-96 97-108  
109-111 113-114 115-118 119-121 122-133 134-137 138-139 140-143  
144-147 148-154 155-167 169-170 172-174 175-186 188-189 191-193  
194-205 207-208 210-212 213-223 224-225 227 228-232 233-237 238-242  
248-253 254-259 263-264 266-268 269-277 278-279 280-283 284-286 287-291  
293-297 298-310 312-313 315-317 318-329 331-332 334-336 337-348 350-351  
353-355 356-363 364-365 369-373 374-378 379-383 389-394 395-400 404-405  
407-409 410-418 419-420 421-424 425-427 428-432 434-438 439-451 453-454  
456-458 459-470 472-473 475-477 478-489 491-492 494-496 497-506 507-508  
511-515 516-520 521-525 531-536 537-542 546-547 549-551 552-560 561-562  
563-566 567-569 570-574 576-578 579-580 581-591 593-594 596-598 599-607  
608-610 611-613 614-628 629-631 633-634 635-638 639-642 643-654 655-657  
659-660 661-664 665-667 668-679 680-682 684-685 686-689 690-693 694-705  
706-708 710-711 712-715 716-718 719-730 731-733 735-736 737-740 741-744  
745-751 752-764 766-767 769-771 772-783 785-786 788-790 791-802 804-805  
807-809 810-820 821-822 825-829 830-834 835-839 845-850 851-856 860-861  
863-865 866-874 875-876 877-880 881-883 884-888 890-894 895-907 909-910

912-914 915-926 928-929 931-933 934-945 947-948 950-952 953-960 961-962  
966-970 971-975 976-980 986-991 992-997 1001-1002 1004-1006 1007-1015  
1016-1017 1018-1021 1022-1024 1025-1029 1031-1033 1034-1035 1036-1046  
1048-1049 1051-1053 1054-1062 1063-1065 1066-1068 1069-1083 1084-1086  
1088-1089 1090-1093 1094-1097 1098-1109 1110-1112 1114-1115 1116-1119  
1120-1122 1123-1134 1135-1137 1139-1140 1141-1144 1145-1148 1149-1160  
1161-1163 1165-1166 1167-1170 1171-1173 1174-1185 1186-1188 1190-1191  
1192-1195 1196-1199 1200-1206 1207-1219 1221-1222 1224-1226 1227-1238  
1240-1241 1243-1245 1246-1257 1259-1260 1262-1264 1265-1275 1276-1277  
1280-1284 1285-1289 1290-1294 1300-1305 1306-1311 1315-1316 1318-1320  
1321-1329 1330-1331 1332-1335 1336-1338 1339-1344 1345-1349 1350-1362  
1364-1365 1367-1369 1370-1381 1383-1384 1386-1388 1389-1400 1402-1403  
1405-1407 1408-1415 1416-1417 1421-1425 1426-1430 1431-1435 1441-1446  
1447-1452 1456-1457 1459-1461 1462-1470 1471-1472 1473-1476 1477-1479  
1480-1484 1486-1488 1489-1490 1491-1501 1503-1504 1506-1508

\*INPUT FILE CHARS

\*PRINT HEADING

\*INPUT FILE ITEMS

## APPENDIX E

Herbarium Specimens of *Pappophorum* scored for NT-SYS analysis.

Herb.	Acc. #	Collector	Coll. #	Date	Locality	Notes	OTU
ARIZ	145451	F Shreve	8386	8/21/1938	Texas, USA		649
ARIZ	214763	JR Reeder, CG Reeder, TR Soderstrom	3278	9/3/1960	Coahuila, Mexico		650
ARIZ	145448	EU Clover	1402	12/2/1933	Texas, USA	Zapata Co, TX	643
ARIZ	256141	JR Reeder, CG Reeder	3939	10/28/1964	Coahuila, Mexico		654
ARIZ	236566	TR Van Devender, L J Toolin	1824	5/29/1982	Texas, USA	Brewster Co, TX	653
ARIZ	256345	JR Reeder, CG Reeder	3917	10/27/1964	Coahuila, Mexico		651
ARIZ	231050	NE Gaza, Jr.	02313	4/4/1981	Texas, USA	McMullen Co, TX	652
ARIZ	279552	T Killeen	1520	11/26/1985	Santa Cruz, Bolivia	duplicates at F #2009207 & MO 3715764	570
ARIZ	219807	J Stroehlein, L Smith	none	8/16/1975	Tabavuela, Ecuador	duplicate at US #2856026	238
ARIZ	279550	T Killeen	1308	10/19/1985	Santa Cruz, Bolivia	duplicate at F #2010782	257
ARIZ	223370	NB Breuninger	328	4/21/1972	Inbabura, Ecuador		258
ARIZ	223360	NB Breuninger	342	4/21/1972	Inbabura, Ecuador		259
ARIZ	250405	O Borsini	657	7/12/1946	Salta, Argentina		260
ARIZ	276081	Castellanos	1702	7/12/1930	Buenos Aires, Argentina		261
ARIZ	276080	Holmberg	40739	4/1/1900	Chaco, Argentina		262

ARIZ	273624	G Starr	87-067	10/2/1987	Coahuila, Mexico		299
ARIZ	279551	T Killeen	1684	1/27/1986	Santa Cruz, Bolivia	duplicates at F #2008390 & MO #3715742	300
ARIZ	254841	TL Burgess, CRM Turner, JE Bowers	6912	4/24/1985	Sonora, Mexico		432
ARIZ	192054	P Cantino	637	2/9/1973	Catamarca, Argentina		433
ARIZ	192049	P Cantino	450	11/20/1972	Catamarca, Argentina		443
ARIZ	276079	E Carette	none	1916	Mendoza, Argentina	note by Reeder on sheet: duplicate at US #2437116 annotated <i>P. philippianum</i> by Rosengurt in 1970	445
ARIZ	276082	E Agusti	none	1917-1918	Catamarca, Argentina		446
ARIZ	264563	EC Tenorio	none	10/24/1970	Pernambuco, Brazil		538
ARIZ	276083	JR Reeder, RS Felger	8090	9/1/1987	Sonora, Mexico		490
ARIZ	207454	JR Reeder, CR Reeder	4517	9/5/1965	Coahuila, Mexico		502
ARIZ	253706	JR Reeder, CG Reeder	4268	7/31/1965	San Luis Patosi, Mexico		489
ARIZ	161887	R Leal	17188	4/15/1955	Mendoza, Argentina		488
ARIZ	252500	TR van Devender, RK van Devender, RP Neilson	84-632	10/31/1984	Coahuila, Mexico		103
ARIZ	269151	PS Martin, MK O'Rourke	none	12/28/1986	Sonora, Mexico		133
ARIZ	262162	PS Martin, MK O'Rourke	none	12/29/1985	Sonora, Mexico		105
ARIZ	192369	P Cantino	602	2/1/1973	Catamarca, Argentina		104
ARIZ	162130	R Leal	17185	4/15/1955	Mendoza, Argentina		434
ARIZ	192053	P Cantino	787	4/10/1973	Catamarca, Argentina		444
ARIZ	192354	P Cantino	690	2/28/1973	Catamarca, Argentina		603
BH	none	Buckley	1883	not given	Texas, USA	mixture of species on sheet	657

BH	none	SM Tracy	8905	4/21/1905	Texas, USA	mixture of species on sheet; Kingsville, TX	664
BH	none	AS Hitchcock	448	9/14/1915	Texas, USA	duplicate coll. by AS Hitchcock at MO #848328; Del Rio, TX	662
BH	none	CG Pringle	none	6/4/1882	Arizona, USA	near Camp Lowell, AZ	663
BH	none	CG Pringle	4814	5/17/1894	Oaxaca, Mexico		406
BH	none	AS Hitchcock	447	8/14/1910	Tomellin, Oaxaca, Mexico	duplicate at MO #848327	407
BH	none	LH Bailey	119	3/25/1936	Sonora-Guaymas, Mexico		422
BH	none	GC Nealley	none	1887	Texas, USA		423
BH	none	LH Bailey, EZ Bailey	49	12/15/1921	Caracas, Venezuela	duplicate? at US #1108178; this specimen has a different collection date, but the collector and collection number is the same; see OTU-553	541
BH	none	W Fischer	43	9/1914-2/1915	Rio Negro, Argentina	duplicate at F #479152 & MO #876702	493
BH	none	Curran, Haman	448	4/1/1917	Vela de Coro, Venezuela		492
BH	none	EO Wooton	none	9/12/1914	Arizona, USA		491
BH	none	Buckley	1883	not given	Texas, USA		656
BH	none	AE Perkins, JM Hall	2041	4/13/1939	Webb Co., Texas, USA		599
BH	none	AS Hitchcock	449	9/11/1915	Tucson, Arizona, USA	duplicate sheet at BH no acc #; see OTU-605	594
BH	none	AS Hitchcock	449	9/11/1915	Tucson, Arizona, USA	duplicate sheet at BH no acc #; see OTU-594	605
BH	none	Buckley	1883	not given	Texas, USA	two species on sheet: <i>P. bicolor</i> & <i>P. vaginatum</i>	656
BH	none	Curran, Haman	448	4/1/1917	Vela de Coro, Venezuela		492
BH	none	W Lossen	274 or 112?	1/25/year not given	Cordoba, Argentina	two species on sheet: <i>P. vaginatum</i> & <i>P. philippianum</i> ; duplicate at F #584f403	420
BH	none	W Lossen	274 or 112?	1/25/year not given	Cordoba, Argentina	two species on sheet: <i>P. vaginatum</i> & <i>P. philippianum</i> ; duplicate at F #584f403	421
BH	none	B Maguire, RR Maguire	11210	5/10/1935	Tucson, Arizona, USA		661

BH	none	W Lossen	274 or 112?	1/25/year not given	Cordoba, Argentina	two species on sheet: <i>P. vaginatum</i> & <i>P. philippianum</i>	419
BH	none	CG Pringle	none	7/28/1881	Arizona, USA	near Camp Lowell, AZ	494
BH	none	FT Hubbard	none	not given	not given	a description of <i>P. apertum</i> which is considered a synonym of <i>P. vaginatum</i>	222
BH	none	W Lossen	182 or 275?	2/25/year not given	Cordoba, Argentina		593
F	2009207	T Killeen	1520	11/26/1985	Santa Cruz, Bolivia	duplicates at ARIZ #279552 & MO #3715764	569
F	165035	T Morong	1071	1888 & 1890	Icomayo River, Paraguay	duplicates at MO #2104082 & US #822076 & US #207493	250
F	2010782	T Killeen	1308	10/19/1985	Santa Cruz, Bolivia	duplicate at ARIZ #279550	254
F	2008390	T Killeen	1684	1/27/1986	Santa Cruz, Bolivia	duplicates at ARIZ #279551 & MO #3715742	255
F	1659350	Rosengurt	B-5837	2/24/1950	Chaco, Paraguay	duplicate at US #2461698	256
F	2081254	AG Schulz	3303	3/19/1942	Chaco, Argentina		359
F	621590	A Weberbauer	6462	1909-1914	Peru		361
F	1941403	T Sanchez V	2963	5/29/1983	Cajamarca, Peru		362
F	754040	DB Pickel	2331	3/19/1934	Pernambuco, Brazil		363
F	139237	HH Smith	none	1898-1899	not given	Santa Marta Exped.	365
F	637559	S Venturi	2546	12/6/1923	Tucuman, Argentina	duplicate at SI no acc #	366
F	720469	AL Cabrera	3116	6/7/1933	Salta, Argentina		367
F	534308	JF MacBride	3238	4/5-8/1923	Huanuco, Peru	duplicate of specimen at US #1256364?: see OTU-239	368
F	1256752	PC Vogl	671	9/2/1940	Venezuela		369
F	584402	W Lossen	182 or 275?	2/25/year not given	Cordoba, Argentina	duplicate at MO #919743?; see OTU-252	370
F	637830	S Venturi	5415	12/22/1927	Sgo. del Estero, Argentina		372

F	1206464	JA Steyermark	56757	5/27/1947	Trujillo, Venezuela		394
F	2082342	A Schinini, L Mroginski	4458	4/16/1972	Corrientes, Argentina		395
F	584403	W Lossen	274 or 112	1/25/year not given	Cordoba, Argentina	duplicate at BH no acc #	415
F	584403	W Lossen	274 or 112	1/25/year not given	Cordoba, Argentina	duplicate at BH no acc #	416
F	2081253	AG Schulz	6182	1/30/1945	Mendoza, San Rafael, Argentina		429
F	2082343	A Schinini	5304	9/13/1972	Corrientes, Argentina		430
F	2082344	A Schinini	5324	9/13/1972	Corrientes, Argentina		431
F	2081252	AG Schulz	3885	4/15/1943	Chaco, Argentina		102
F	1659348	Rosengurtt	B-7620	12/5/1958	Cordoba, Argentina		101
F	1842385	Legname, Medina, Guezzo	101980		Salta, Argentina		134
F	1931167	G Fotius	3257	12/22/1982	PE - Petrolina?		535
F	900176	A Castellanos	89	2/8/1919	Cordoba, Argentina		487
F	1808492	J Brizuola	279	12/26/1949	Tucuman, Catamarca, Argentina		486
F	479152	W Fischer	43	9/1914- 2/1915	Rio Negro, Argentina	duplicate at BH no acc # & MO #876702	485
F	1847335	G Davidse, M Ramia, R Montes	4615	12/1/1973	Bolivar, Venezuela		645
F	561315	A Chase	7815	11/29- 30/1924	Paulo Alfonso Faalls, Alagoas, Brazil	duplicates at MO #924265 & US #1257330	215
F	1055752	WJ Eyerdam	24877	3/17/1939	Bolivia		644
F	2079484	AG Schulz	10651	10/26/1959	Chaco, Argentina?		219
F	2082215	S Alfredo	171	12/29/1978	Salta, Argentina		221
F	1401878	T Meyer	3143	2/7/1940	Jujuy, Argentina		220

F	561291	A Chase	7767	11/21/1924	Pernambuco, Brazil	364
F	1547285	WMA Brooke	5117	1/16/1949	Bolivia	224
F	1061674	Ragonese	2079	11/19/1935	Santa Fe, Argentina	217
F	50569	PG Lorentz, G Hieronymus	376	2/1873	Salta, Argentina	216
F	900178	A Castellanos	13	1/2/1919	Cordoba, Argentina	484
F	1997471	T Killeen	1729	2/1/1986	Santa Cruz, Bolivia	568
F	1491994	WJ Eyerdam, AA Beetle, E Grondona	23508	12/16/1938	Buenos Aires, Argentina	218
LP	none	J Brizuela	461	1/14/1950	Catamarca, Argentina	32
LP	none	DL Anderson	1289	2/21/1968	San Luis, Argentina	33
LP	none	AL Cabrera, EM Zardini, N Deginani, FO Zuloaga	24545	1/24/1974	San Juan, Argentina	35
LP	290558	JR Guinazii	20	not given	San Luis, Argentina	36
LP	263116	G Dawson	3434	2/1962	La Rioja, Argentina	37
LP	007710	Ragonese	2079	11/19/1935	Santa Fe, Argentina	38
LP	263164	G Dawson	3398	2/1962	La Rioja, Argentina	39
LP	none	AL Cabrera	19550	11/17/1968	Rio Negro, Argentina	41
LP	017383	S Venturi	4474	4/17/1926	Tucuman, Argentina	43
LP	none	Anderson	1290	2/21/1968	San Luis, Argentina	21
LP	034556	A Birdarolli	1555	2/6/1940	Cordoba, Argentina	22
LP	none	TM Pedersen	10055	4/2/1972	Corrientes, Argentina	23
LP	038882	M Isabel, H Scott, Biraben	1412	3/15/1939	Salta, Arentina	24
LP	043280	LR Parodi	14073	2/1941	Catamarca, Argentina	25



LP	none	LJ Nuvara	3083	1/26/1983	Salta, Argentina	26
LP	900997	D Abbiatti, L Claps	47	9/2/45	Salta, Argentina	27
LP	017394	S Venturi	1974	1/17/1983	Tucuman, Argentina	28
LP	007717	MM Job	1174	2/1/1936	Santa Fe, Argentina	29
LP	076174	E Asplund	7044	8/20/1939	Pichincha, Ecuador?	30
LP	none	Rosengurtt	5843	2/25/1950	Chaco, Paraguay	312
LP	none	not given	none	1896?	not given	69
LP	017937	MA Vignati	408	6/1934	San Luis, Argentina	90
LP	891365	TM Petersen	1747	10/6/1952	Corrientes, Argentina	82
LP	901724	AL Cabrera, JM Marchionni	13041	3/13/1958	Salta, Argentina	93
LP	050059	T Meyer	3578	2/2/1941	Salta, Argentina	77
LP	040317	AR Leal	7322	1/23/1941	Mendoza, Argentina	20
LP	none	J Briguela	279	12/26/1946	Catamarca, Argentina	18
LP	none	RM Bruzzzone	1590	11/24/1944	Santiago del Estero, Argentina	19
LP	034410	A Bridarolli	1220	1/25/1940	Cordoba, Argentina	34
LP	018756	Stuckart	135	1920	Cordoba, Argentina	42
LP	none	Bissio	624	2/21/1978	Santa Fe, Argentina	10
LP	none	F Kurtz	14378	2/19-23/1907	La Rioja, Argentina	9
LP	none	DL Anderson	1235	11/17/1967	San Luis, Argentina	7
LP	none	LR Parodi	10474	not given	Buenos Aires, Argentina	52
LP	039813	M Isabel, H Scott de Biraben, M Biraben	354	2/4/1938	Buenos Aires, Argentina	51

LP	none	not given	none	2/1898	not given	56
LP	561490	AL Cabrera	10666	11/27/1950	Buenos Aires, Argentina	44
LP	none	O Boelcke, MN Correa, N Baiigalupo	11931	12/8/1964	Buenos Aires, Argentina	47
LP	none	AL Cabrera, HA Fabris	16431	12/3/1964	Buenos Aires, Argentina	46
LP	052654	AL Cabrera	8137	11/23/1963	Buenos Aires, Argentina	53
LP	052686	AL Cabrera	8046	11/12/1942	Buenos Aires, Argentina	49
LP	none	O Boeleke	1528	11/17/1961	Buenos Aires, Argentina	48
LP	054345	LR Parodi	14618	2/9/1943	Jujuy, Argentina	13
LP	none	AL Cabrera	15056	2/13/1963	Jujuy, Argentina	70
LP	043228	LR Parodi	14358	2/12/1941	Catamarca, Argentina	91
LP	905490	G Dawson	3234	3/1959	Buenos Aires, Argentina	58
LP	007706	MM Job	1113	2/1/1936	Santa Fe, Argentina	78
LP	none	AL Cabrera, OT Solbrig, MA Torres, B Vuillemier	16750	2/27/1965	Catamarca, Argentina	71
LP	040033	G Covas	1303	2/17/1941	LaRioja, Argentina	88
LP	039196	M Biraben	180	11/20/1939	Santa Fe, Argentina	80
LP	none	AL Cabrera	15079	2/15/1963	Jujuy, Argentina	85
LP	905521	G Dawson	3243	3/1959	Mendoza, Argentina	59
LP	none	AJ Cdeontaic?	5339	3/26/1972	Jujuy, Argentina	65
LP	017432	MM Job	1307	1/1937	Catamarca, Argentina	64
LP	none	HA Fabris, JV Crisci	6831	3/8/1967	Jujuy, Argentina	62
LP	none	O Boelcke	1543	11/17/1961	Buenos Aires, Argentina	45

LP	290245	RM Bruzzone	1598	11/25/1944	Santiago del Estero, Argentina	12
LP	049663	R M Bruzzone	1222	2/18/1942	San Luis, Argentina	14
LP	none	F Kurtz	13288	1/27/1906	Cordoba, Argentina	73
LP	none	not given	none	2/1898	not given	50
LP	040123	Contardi	9	11/20/1929	Mendoza, Argentina	87
LP	042450	G Covas	1005	11/9/1940	San Luis, Argentina	89
LP	none	C Ballespin	none	1959	La rioja, Argentina	84
LP	038959	M Isabel, HS Biraben, M Biraben	1181	3/6/1939	Catamarca, Argentina	83
LP	049632	not given	none	2/13/1942	Mendoza, Argentina	68
LP	017449	MM Job	1481	1/1937	Salta, Argentina	63
LP	none	AL Cabrera, DA Suarez, MA Torres, J Crisci, N Tur	17886	2/21/1976	San Luis Argentina	60
LP	none	AL Cabrera, EM Zardini, N Deginani, FO Zuloaga	24634	1/27/1974	La Rioja, Argentina	57
LP	043303	LR Parodi	13940	2/1941	Catamarca, Argentina	74
LP	018759	Bruch-Carette	none	2/1914	San Luis, Argentina	92
LP	043225	LR Parodi	14362	2/12/1941	Catamarca, Argentina	72
LP	none	SE Ricci	327	12/19/1982	Buenos Aires, Argentina	55
LP	039598	AL Cabrera	6300	2/29/1960	La Plata, Argentina	54
LP	050124	R Maldonado	921	1/26/1942	Sgo Del Estro, Argentina	81
LP	none	K Okada	3773	2/23/1971	Jujuy, Argentina	86
LP	038942	R Maldonado	513	11/12/1940	Sgo Del Estero, Argentina	76

LP	none	AL Cabrera, N Deginani, R Giangualani, R Kiesling, F Zuloaga	26531	4/28/1975	Salta, Argentina		79
MO	3449117	R Diaz	111	10/19/1984	Tamaulipas, Mexico		646
MO	996082	Marcus E. Jones, AM?	26265?	4/21/1930	Texas, USA	coll. name and # difficult to distinguish	647
MO	3112299	MC Johnston, TL Wendt, FChiang C.	11625	7/5/1973	Mexico		676
MO	703344	CR Orcuff	5722	not given	Texas, USA		670
MO	982061	EJ Palmer	33848	5/9/1928	Texas, USA	Frio Co, TX	671
MO	1271548	BC Tharp	none	6/25/1941	Calarina?		672
MO	1228680	LH Harvey	896	6/15/1939	Texas, USA		648
MO	3343413	IG Itie	108994	9/6/1952	Mexico		677
MO	848328	AS Hitchcock	448	9/14/1915	Texas, USA	duplicate coll. by AS Hitchcock at BH (no acc. #); Del Rio, TX	666
MO	3343414	J Marroquin	3398	10/25/1975	Coahuila, Mexico	Buenavista, Saltillo, Mexico	669
MO	856421	EJ Palmer	14488	9/24/1918	Texas, USA	Uvalde Co, TX	673
MO	2975948	H Eggert	none	9/11/1900	Texas, USA	Valverde, TX	674
MO	2641595	RW Pohl, G Davidse	11800	5/30/1970	Texas, USA	LaSalle Co, TX	675
MO	2618430	DSCorrell, DC Wasshausen	27728	6/13/1963	Texas, USA		655
MO	2663996	RW Pohl	12464	8/7/1970	San Luis, Mexico	Potosi, Matahuala, Mexico	658
MO	3482701	JC Solomon, RM King	15904	4/4/1987	Cochabamba, Bolivia	Cercado Prov., Bolivia	567
MO	3520133	S Toledo	1175	3/15/1986	Salta, Argentina		572
MO	3595520	DR Brunner	1674	3/26/1986	Nueva Asuncion, Paraguay		573
MO	3715764	T Killeen	1520	11/26/1985	Santa Cruz, Bolivia	duplicates at ARIZ #279552 & F #2009207	576
MO	987352	RS Ferris	5616?	10/22/1925	Tres Marias Islands, Mexico	Maria Madre, Tres Marias Islands, Mexico	236

MO	848327	AS Hitchcock	447	8/14/1910	Tomellin, Mexico	Tomellin, Oaxaca, Mexico; duplicate at BH no acc # -- see OTU-	251
MO	919743	W Lossen	182	2/25/year not given	Cordoba, Argentina	duplicate at F #584402?; see OTU-370	252
MO	2312567	GJ Schwarz	9958	3/3/1950	Corrientes, Argentina		272
MO	3715742	T Killeen	1684	1/27/1986	Santa Cruz, Bolivia	duplicates at ARIZ #279551 & F #2008390	273
MO	3275387	S Llatas Q	363	11/25/1978	Chiclayo, Peru		281
MO	3032032	H Ellenberg	457	3/14/1971	Puquio, Peru		282
MO	3040566	SA Renvoize, TA Cope, S Beck	4226	6/4/1981	La Paz, Murillo, Bolivia		283
MO	1824884	T Meyer	12710	5/6/1919	Salta, Argentina	note on sheet stating that it is a duplicate of one cited by Pensio. 1986. Darwiniana. 27: 71	284
MO	2883430	T Stuckert	12	2/28/1908	Chaco, Argentina		285
MO	2221303	TM Pedersen	10055	7/2/1972	Corrientes, Argentina		286
MO	1789195	TH Goodspeed	33159?	4/22/1943	Lima, Peru		301
MO	3631919	ELPG de Oliveira	497	3/9/1982	Monta-Haberaba		302
MO	2997058	G Davidse, TP Ramamoorthy & DM Vital	1165	3/31/1976	Bahia, Brazil		303
MO	808479	P Jorgensen	1700	3/1916	Catamarca, Argentina		304
MO	2887696	T Stuckert	17122	3/12/1904	Cordoba, Argentina		305
MO	2693071	A Allem, G Vieira	1740	3/2/1978	Bahia, Brazil		306
MO	3634963	J Jaramillo	7639	5/21/1985	Pichincha, Ecuador		307
MO	3592723	A Castillo	2535	8/15/1987	Vargas, Venezuela		308
MO	3631920	ELPG de Oliveira	460	7/13/1982	Calderao-Itaberaba		309
MO	2392720	A Schinnini, R M Crovetto	12788	3/27/1976	Corrientes, Argentina		311
MO	3673474	AG Schulz	3885	4/15/1943	Chaco, Argentina		312

MO	2879316	T Stuckert	8960	2/20/1900	Cordoba, Argentina		313
MO	2997057	G Davidse, TP Ramamoorthy & DM Vital	11834	4/3/1976	Brazil		314
MO	2811092	SA Mori, RM King	none	7/13/1979	Maracas, Brazil		315
MO	2145975	G Davidse	2886	11/6/1971	Federal Dist., Venezuela		316
MO	2942099	A Allem, J Valls, G Vieira, J Comastri	2234	10/28/1978	Corumba, Brazil		317
MO	2145979	G Davidse	2909	11/7/1971	Miranda, Venezuela		318
MO	2313407	R Chavez	3218	4/25/1975	Abancay, Peru		334
MO	2312576	MR Malvarez	327	12/20/1946	Salta, Argentina	duplicate at US #2153215	335
MO	2879872	T Stuckert	15844	5/9/1906	Cordoba, Argentina		336
MO	2887077	T Stuckert	13808	2/1904	Cordoba, Argentina		337
MO	2879317	T Stuckert	14039	3/1904	Cordoba, Argentina		338
MO	2629150	J Conrad, W Dietrich	2445	1/26/1974	Cordoba, Argentina		339
MO	3695829	LJ Novar	3083	1/26/1983	Salta, Argentina		340
MO	2693070	A Allem, G Vieira	1315	11/17/1977	Mato Grosso, Brazil		371
MO	2586096	JA Steyermark, VC Espinoza	112733	10/10/1976	Liberador, Venezuela		373
MO	2996953	GS Bunting	9361	7/5/1980	Zulia, Venezuela		374
MO	3852317	PM Peterson, EJ Judziewiez, RM King	9095	5/12/1990	Carchi, Ecuador		375
MO	3852348	PM Peterson, EJ Judziewiez, RM King	9066	10/10/1990	Ecuador		376
MO	3631548	I Sanchez V	2963	5/29/1983	Cajamarca, Peru		377
MO	49341	HH Smith	2536	1888-1901	Santa Marta, Colombia		378

MO	2104082	T Morong	1071	1888-1890	Pilcomayo, Paraguay	duplicates at F #165035 & US #207493 & US #822076	380
MO	960401	S Venturi	2802	1/6/1924	Tucuman, Argentina		381
MO	1826515	F Fagerlind, G Wibom	1314	11/19/1952	Prov. Imbabura ?		383
MO	866810	P Jorgenson	3099	4/1919	Formosa, Argentina		384
MO	3032061	H Ellenberg	325 or 3972?	1/10/1971	Huanuco, Peru		385
MO	847688	E Hassler	12870	1913	Ypacaray, Paraguay		386
MO	956720	S Venturi	5715	12/22/1927	Sqo. del Estero, Argentina	duplicates at SI no acc # & US #1386912	388
MO	3713964	F Zuloaga, R Ortiz	4297	8/2/1987	Vargao, Venezuela		396
MO	2975960	CG Pringle	4814	8/18/1894	Oaxaca, Mexico		403
MO	970023	ME Jones	23440	1/26/1927	Sonora-Guaymas, Mexico		424
MO	2996943	H Ellenberg	4517	2/17/1971	Las Salinas, Argentina		427
MO	3698652	JF Pensiero	352	9/17/1982	Las Colonias, Santa Fe, Argentina		456
MO	2824283	Rosengurtt?	none	7/4/1977	Cordoba, Argentina		466
MO	2879318	T Stuckert	14708	12/1904	Cordoba, Argentina		469
MO	1824886	J Semper	none	2/18-19/1944	San Luis, Argentina	note written near collector: dup. Swallen I 1950?	470
MO	3695118	E Nicora, E Gomez-Sosa, M Mul Gura	8434	not given	San Juan, Argentina		476
MO	809281	P Jorgensen	1355	2/20/1915	Catamarca, Argentina		477
MO	2879314	not given	none	12/19/1905	Cordoba, Argentina		478
MO	2312578	A Brizuela	478	1946	Catamarca, Argentina		480

MO	2975955	C Wright	803	5-10/1849	Texas, USA	note on sheet stating that it is an isotype of <i>P. vaginatum</i> - according to AS Hitchcock; see notes on OTU-4; duplicate at MO #2975956; <i>P. apertum</i> on original label - see OTU-5	3
MO	2975955	C Wright	803	5-10/1849	Texas, USA	see notes on OTU-3; appears to be a mixture of specimens on sheet; duplicate at MO #2975956; <i>P. apertum</i> on original label - see OTU-5	4
MO	2975956	C Wright	803	5-10/1849	Texas, USA	note on sheet stating that it is an isotype of <i>P. vaginatum</i> - according to AS Hitchcock; see notes on OTU-3 & 4; duplicate at MO #2975955; <i>P. apertum</i> on original label	5
MO	2975957	CG Pringle	13924	7/28/1881	Arizona, USA	near Camp Lowell; original label reads <i>P. alopecuroides</i> , that is marked through with <i>P. apertum</i> ; note on sheet reading that this is an isotype of <i>P. apertum</i>	6
MO	2066730	not given	none	not given	not given		157
MO	1308795	Schreiter	8467	3/18/1928	Tucuman, Argentina		137
MO	3631921	T Sendulsky	1442	1/1975	Sao Paulo, Brazil		544
MO	2991875	TS Filgueiras	872	5/3/1981	Gama, Valparaiso, Brazil		545
MO	2464131	PE Berry	401	10/9/1974	Caracas, Venezuela		537
MO	2668676	C Burandt, Jr	V0205	5/21/1978	Palavccino, Venezuela?		536
MO	924265	A Chase	7815	11/29-30/1924	Paulo Affonso Falls, Alagoas, Brazil	duplicates at F #561315 & US #1257300	550
MO	none	C Nelson	8471	9/14/1982	Islas de la Bahia, Honduras		546
MO	2266973	RM Harley, SA Renvoize, CM Erskine, CA Brighton, R Pinheiro	16392	2/26/1974	Estado de Bahia, Brazil		549
MO	2266974	RM Harley, SA Renvoize, CM Erskine, CA Brighton, R Pinheiro	1637	2/26/1974	Estado de Bahia, Brazil		539



MO	2994132	C Raunier	1765	9/30/1981	Guanare?		540
MO	2399859	G Davidse, M Ramia, R Montes	4615	12/2/1973	Bolivar, Venexuela		547
MO	3301908	WL Wagner, L Brown	3930	8/15/1978	Durango, Mexico		521
MO	2887078	T Stuckert	11259	1/1902	Cordoba, Argentina		505
MO	2877745	T Stuckert	11042	2/1/1902	Cordoba, Argentina		503
MO	2879313	T Stuckert	13807	3/1/1904	Cordoba, Argentina		506
MO	3112353	F Chiang, T Wendt, MC Johnston	8275	7/5/1972	Coahuila, Mexico		500
MO	2975958	E Palmer	377	1898	Saltillo, Coahuila, Mexico		499
MO	3112354	F Chiang, T Wendt, MC Johnston	9105	9/2/1972	Coahuila, Mexico		527
MO	919742	W Lossen	112	not given	Argentina?		498
MO	1300514	Krapovickas	2619	10/28/1945	Buenos Aires, Argentina	duplicate at US #1564037	497
MO	826702	W Fischer	43	9/1914- 2/1915	Rio Negro, Argentina	duplicate at BH no acc # & F #479152	496
MO	2887079	T Stuckert	11253	1/1902	Cordoba, Argentina		495
MO	2109989	KK Mackenzie	113	8/1899	Laredo, Texas, USA		483
MO	2477351	O Boeleke	8542	1/29/1956	Buenos Aires, Argentina		596
MO	3599114	JC Solomon, M Nee	17997	3/9/1988	Santa Cruz, Bolivia		621
MO	3677559	J Solomon, A Solomon	4108	12/12/1978	Cordoba, Argentina		619
MO	3695117	E Nicora, E Gomez-Sosa, M Mulgura	8431	1/11/1983	San Juan, Argentina		618
MO	3040565	SA Renvoize, TA Cope, S Beck	4065	3/24/1981	Santa Cruz, Florida, USA	duplicate at US #2931016	617
MO	2387349	TW Bocher, JP Hjerting, K Rahn	2211	1/8/1956	Mendoza, Argentina		616

MO	709680	CR Orcutt	6091	5/1913	Valverde Co., Texas, USA		201
MO	814433	EJ Palmer	10214	6/16/1916	Uvalde Co., Texas, USA		100
MO	3705518	F Escalona, J Escalona	V217	1/22-25/1985	Venezuela		123
MO	2399858	G Davidse, M Ramia, R Montes	4976	12/8/1973	Venezuela		159
MO	986705	S Venturi	10168	3/16/1930	Sgo. del Estero, Argentina		457
MO	2109988	not given	none	not given	not given		379
MO	924264	A Chase	7767	11/21/1924	Pina to Boa Viagern, Brazil	duplicate at US #1257302	124
MO	1625890	IM Johnston	8885	9/8/1941	Coahuila, Mexico		668
MO	1114183	FL Wynd, CH Mueller	203	6/19/1936	Coahuila, Mexico		659
MO	1228679	LH harvey	939	6/19/1939	Coahuila, Mexico		660
MO	1246406	WJ Eyerdam, AA Beetle, E Grondona	23508	12/16/1938	Argentina		175
MO	2477350	O Boelcke	9907	1/14/1963	Mendoza, Argentina	two species on sheet: <i>P.</i> <i>vaginatum</i> & <i>P.</i> <i>philippianum</i>	99
MO	2975954	CG Pringle	none	6/4/1882	Arizona, USA	near Camp Lowell, AZ	203
MO	2975949	H Eggert	none	4/6/1901	Webb Co., Texas, USA		202
MO	2975952	J Reverchon	none	4/1882	Fort Coneho?, USA		198
MO	1277911	BC Tharp	43-502	6/24/1943	Pecos Co., Texas, USA		204
MO	3248613	M Nee, G Diggs	25324A	7/27/1982	Coahuila, Mexico		115
MO	2975951	SM Tracy	8905	4/21/1905	Kingsvill, Texas, USA		195
MO	3677558	PM Casasola, S Castillo, F Rodriguez, I Pisanty, G Garcia, T Garcia	153	7/18/1981	Veracruz, Mexico		235

MO	2477350	O Boelcke	9907	1/14/1963	Mendoza, Argentina	two species on sheet: <i>P. vaginatum</i> & <i>P. philippianum</i>	98
MO	1631167	IM Johnston	8641	8/30/1941	Coahuila, Mexico		526
MO	703350	CR Orcutt	5725	3-4/1913	Laredo, Texas, USA		192
MO	803285	MS Young	none	8/26/1915	San Vicente, Texas, USA		200
MO	982053	EJ Palmer	33874	5/9/1928	Frio Co., Texas, USA		199
MO	2975957	CG Pringle	13924	7/28/1881	Arizona, USA	near Camp Lowell, AZ; classified as type specimen of <i>P. alopecuroides</i> ? = <i>P. vaginatum</i> , according to US	6
MO	2629169	J Conrad	2403	1/22/1974	La Pampa, Argentina		160
MO	3504538	S Toleds	1280	1/16/1987	Salta, Argentina		191
MO	2109982	not given	none	not given	Montevideo?		520
MO	3677557	JC Solomon, M Nee	16071	2/14/1987	Bolivia		172
MO	2109980	E Hassler	2596	1903	Paraguay		173
MO	2693069	A Allem, G Vieira	1388	11/20/1977	Alegria, Brazil		176
MO	1308796	not given	none	12/30/1925	Tucuman, Argentina		174
MO	2109981	T Stuckert	238	1902	Argentina		122
MO	2586095	A Allem, G Vieira	954	7/19/1971	Corumba, Brazil		166
MO	3040567	SA Renvoize, TA Cope, S Beck	4225	6/4/1981	La Paz, Bolivia		164
MO	962405	S Venturi	7822	12/27/1928	La Rioja, Argentina		162
MO	1308774	Lillo	4853	2/18/1906	Tucuman, Argentina	two collections on same sheet; see OTU-96	97
MO	1308774	Rodriquez	248	12/28/1911	Tucuman, Argentina	two collections on same sheet; see OTU-97	96
MO	2887076	T Stuckert	17259	3/12/1907	La Rioja, Argentina		163
MO	2738110	B Hammel	5924	12/22/1978	La Banda, Argentina		425

MO	2942077	A Allem, J Valls, G Vieira, J Comastri	2266	10/30/1978	Rio Negro, Brazil	575
MO	2821531	SA Renvoize, M Wilmot- Dear, N Tur	3608	11/26/1978	Corrientes, Argentina	426
MO	2415366	G Davidse, A Gentry, F Llanos	5574	1/8/1974	Colombia	548
MO	2975959	not given	39	not given	Montevideo?	387
MO	2392701	A Schinini, O Ahumada	12360	1/10/1976	Corrientes, Argentina	583
MO	2821530	SA Renvoize, M Wilmot- Dear, N Tur	3571	11/22/1978	Corrientes, Argentina	580
MO	3695125	TM Pedersen	11558	7/1/1977	San Luis, Corrientes, Argentina	578
MO	1227739	LH Harvey	1240	7/21/1939	Coahuila, Mexico	667
MO	1308794	Schreiter	4501	12/30/1925	Zucuman, Argentina?	382
MO	2811091	SA Mori	31278	2/28/1980	Iacu, Brazil	597
MO	848325	AS Hitchcock	450	7/10/1910	Saltillo, Mexico	145
MO	3042955	JW Thieret, D Brandenburg	53004	5/27/1982	Pima Co., Arizona, USA	205
MO	2879315	T Stuckert	18472	1/17/1908	Cordoba, Argentina	193
MO	2975953	Thomber	206	8/6/1903	Tucson, Arizona, USA	194
MO	703356	CR Orcutt	5733	3-4/1913	Laredo, Texas, USA	196
MO	848326	AS Hitchcock	449	9/11/1915	Tucson, Arizona, USA	197
MO	3112355	F Chiang, T Wendt, MC Johnston	9057	8/31/1972	Coahuila, Mexico	108
MO	2879312	T Stuckert	12448	12/30/1902	Cordoba, Argentina	504
MO	1289549	TH Goodspeed, A Weberbauer	33070	3/15-22/1942	Huarochiri, Peru	155
MO	3313435	A Fernandez	1331	1985	Dep Fed Isla Orchila	156

MO	2066731	Pere Duss?	1329	1880	La Martinique?		158
MO	2693072	A Allem, G Vieira	1272	11/16/1977	Corumba, Brazil		130
MO	2617174	GJ Schwarz	9874	2/28/1950	Corrientes, Argentina		138
SI	none	A Castany	8	3/3/1958	Chaco, Paraguay	notes and illustrations attached to sheet along with specimen	228
SI	none	S Venturi	2546	12/6/1923	Tucuman, Argentina	duplicate at F #637559	341
SI	none	MM Job	1174	2/1/1936	Santa Fe, Argentina		342
SI	none	A Burkart	12180	3/4/1941	La Rioja, Argentina		343
SI	none	AG Schulz	3885	4/15/1943	Chaco, Argentina?		344
SI	none	S Venturi	725	12/1919	Tucuman, Argentina	duplicate at US #1547062	348
SI	none	ML Giardelli	1044	1/20/1938	Cordoba, Argentina		349
SI	none	S Venturi	5715	12/22/1927	Sge. del Estero, Argentina	duplicates at MO #956720 & US #1386912	397
SI	none	A Burkart	10215	1/19/1940	Cordoba, Argentina		398
SI	none	JR Baez	39	1/16/1941	Chaco, Argentina?		399
SI	none	R Bazzi	170	1919	Chaco, Argentina?		400
SI	none	not given	none	6/12/1938	Cordoba, Argentina		401
SI	none	M Sayago	1519	2/13/1953	Cordoba, Argentina		402
SI	none	Joergensen	1708	1915	Catamarca, Argentina		404
SI	72868	E Sanchez, M Arriaga	1331	1/21/1983	La Rioja, Buenos Aires, Argentina		417
SI	none	E Wahnish	2050	12/27/1938	Mal Paso, Argentina		435
SI	none	E Nicora	17535	3/1/1941	Cordoba, Argentina		467
SI	18507	TG Nicora	none	3/12/1942	Catamarca, Argentina		473

SI	18521	TG Nicora	none	3/14/1942	Gohernado, Gordillo, La Reoji, Argentina	474
SI	none	E Nicora, E Gomes-Sosa, J Pensiero, Z Rugola	9159	2/25/1987	La Poma, Argentina	475
SI	none	A Burkart, NS Tronsoso, EG Nicora	13875	2/22/1942	Mendoza, Argentina	479
SI	none	F Vervoorst, VM Barigalupo MN Correa	4309	4/2/1971	Salta, Argentina	620
SI	none	G Covas	1570	3/20/1944	Mendoza, Argentina	600
SI	none	G Covas	1570	3/21/1944	Mendoza, Argentina	598
SI	none	G Covas	3648	2/10/1945	Mendoza, Argentina	611
SI	none	Krapovickas	6623	1/9/1950	Cordoba, Argentina	610
SI	none	G Covas	1280	5/16/1943	Mendoza, Argentina	609
SI	53	A Castellanos	13	1/2/1919	Cordoba, Argentina	
SI	none	A Burkart	122071/2	2/17/1941	La Rioja, Argentina	606
SI	84	A Castellanos	89	2/8/1919	Cordoba, Argentina	604
SI	none	A Burkart	12204	2/17/1941	La Rioja, Argentina	642
SI	none	Sayago	1511	2/13/1953	Catamarca, Argentina	639
SI	none	A Burkart	10143	1/9/1940	Cordoba, Argentina	638
SI	none	S Venturi	566	10/1919	Chauar, Argentina	637
SI	72825	E Sanchez, M Arriaga	1273	1/18/1983	Cordoba, Argentina	607
SI	none	A Burkart	15825	2/10/1948	La Pampa, Argentina	211
SI	none	CB Vikamil, EG Nicora	2164	11/20/1982 or 1981	Buenos Aires, Argentina	206
SI	none	A Burkart	24068	4/11/1963	Entre Rios, Argentina	209

SI	none	A Burkart, NS Troncoso	26148	12/14/1965	Entre Rios, Argentina		214
SI	none	G Covas	940	1/16/1943	Mendoza, Argentina		213
SI	none	A Burkart	10139	1/9/1940	Cordoba, Argentina		574
SI	none	M Sayago	1520	2/13/1953	Catamarca, Argentina?		612
SI	none	AL Cabrera, S Botta, AM Ragonese, M Sancho, N Troncoso	31226	12/14/1979	San Juan, Argentina		640
SI	none	Krapovickas	7293	11/12/1950	Cordoba, Argentina		207
SI	none	E Nicora, E Gomez-Sosa, M Mulgura	8434	1/11/1983	San Juan, Argentina		161
SI	none	T Stuckert	17216	3/12/1907	Rioja, Argentina		226
SI	none	G Covas	688	12/5/1942	Mendoza, Argentina		139
SI	none	G Covas	3424	2/15/1945	Mendoza, Argentina		140
SI	none	A Burkart, MN Bacigalupo	21077	1/19/1960	Entre Rios, La Plata, Argentina	appeared to be two specimens on same sheet; only one is present	95
SI	none	A Burkart, MN Bacigalupo	21077	1/19/1960	Entre Rios, La Plata, Argentina	appeared to be two specimens on same sheet; only one is present	94
SI	none	S Venturi	639	12/1919	Tucuman, Argentina		436
SI	2077	Giacobis	40	2/1938	San Luis, Argentina		468
SI	none	A Burkart	25261	5/18/1964	Entre Rios, Argentina		208
SI	none	C Quarin	2341	4/7/1974	Corrientes, Argentina		582
SI	none	E Nicora	4005	2/14/1944	Rio Negro, Argentina		641
SI	none	R Scolnik	1743	12/30/1951	not given		210
SI	none	A Burkart	25606	12/8/1964	Buenos Aires, Argentina		212

SI	none	Itria	17410	3/30/1947	La Pampa, Argentina		613
SI	none	AL Cabrera, S Botta, C Ezcurra, R Kiesling	32814	12/5/1981	La Pampa, Argentina		601
SI	none	R Kiesling, S Meglioli	6617	1/27/1987	San Juan, Argentina		227
SI	none	HH Bartlett	20592	7/7/1943	San Luis, Argentina		636
US	2012856	E Anderson	1174	3/22/1950	Chaco, Paraguay		563
US	1962715	M Cardenas	3917	3/1947	San Pedro, Bolivia		564
US	2790563	C Saravia	2915	10/20/1963	Colombia		565
US	2153597	E Budin	13347	12/13/1906	Formosa, Argentina		566
US	2013349	HC Culter, M Cardenas	10016	2/8/1947	San Pedro, Bolivia		571
US	726079	E Hassler	12089	1912/1913	Paraguay		577
US	899535	E. Hassler	9527	1905	Paraguay		579
US	2010552	M Acosta	16398	4/15/1950	Pichincha, Ecuador		229
US	2461698	Rosengurtt	B-5837	2/24/1950	Chaco, Paraguay	duplicate at F #1659350	230
US	2043871	F Meyer	12170	5/6/1947	Salta, Argentina		231
US	2931013	SA Renvoize, TA Cope, S Beck	3880	9/3/1981	Chuquisaca, Bolivia		232
US	1386877	S Venturi	2546	12/6/1923	Burrajaeae?, Argentina		234
US	1911556	M Acosta	10580	7/20/1945	Ecuador		237
US	1256364	JF MacBride	none	4/5-8/1923	Huanuco?, Peru	duplicate of specimen at F #534308?; see OTU-368	239
US	2182628	Jorgensen	1708	1915	Catamarca, Argentina		240
US	990550	NL Britton, JF Cowell, WE Hess	1777?	2/20-26/1914	Mona Island, Porto Rico		241
US	1129497	Eggen	none	10/1881	Corwelli Hill, St. Thomas		242



US	559406	AS Hitchcock	254	3/23/1906	Tricornia, Cuba		243
US	1387307	EL Ehman	13149	9/9/21	Havana, Cuba		244
US	1060626	Bro. Leon	9028	11/1919	Havana, Cuba		245
US	1387576	EL Ekman	952	5/17/1914	Havana, Cuba	sheet has note stating it agrees with type	246
US	899524	Bro. Leon	2010	12/8/1910	Havana, Cuba		247
US	207493	T Morong	1071	1888 & 1890	Icomayo River, Paraguay	duplicates at F #165035 & MO #2104082 & US #822076; material on sheet; see US OTU-249	248
US	207493	T Morong	1071	1888 & 1890	Icomayo River, Paraguay	duplicates at F #165035 & MO #2104082 & US #822076; material from envelope; see OTU-248	249
US	1517203	A Weberbauer	6462	3/1913	Tayacaja, Peru		253
US	1498106	A Weberbauer	6462	1909-1914	Peru		263
US	1645464	Y Mexia	7365	6/23-24/1935	Imbabura, Peru		264
US	2951792	Rosengurtt	B-5843	2/25/1950	Chaco, Paraguay		265
US	2474238	C Vargas	14346	3/15/1963	Anta, Peru		266
US	1296013	G Niedfeld	6477	summer/1925	Cordoba, Argentina		267
US	1859631	Jorgensen	1708	3/2/1916	Catamarca, Argentina		268
US	1099584	Caballerouie	4921	2/27/1908-9	N. Paraguay		269
US	1037381	E Hassler	12470	1913	Paraguay		270
US	730183	AS Hitchcock	9939	11/21/1912	Sabanilla, Colombia		274
US	2075078	M Acosta Solis	19042	9/15/1950	Imbabura, Ecuador		275
US	1561952	JC Mutis	5547	1760-1808?	Colombia		276
US	1961331	JR Swallen	9468	6/18/1946	Ponta Pora, Bella Vista, Brazil	written on sheet: cf Pensiero, Darwiniana 27: 72 1986	277
US	822076	T Morong	1071	1888-1890	Pilcomayo River, Paraguay	duplicates at F #165035 & MO #2104082 & US #207493	278
US	899531	M Lilio	4465	5/20/1905	Salta, Argentina		279

US	2473914	RP Belem, JM Mendes	352	1/29/1965	Rodovia, Brazil		280
US	1386912	S Venturi	5715	12/22/1928	Sgo del Estero, Argentina	perhaps duplicate of SI specimen no acc #, duplicate of MO #956720	287
US	2931509	M Vavrek	371	9/24/1981	Fte. Enciso Nat. Park, Paraguay		288
US	2010343	M Acosta Solis	11317	11/30/1945	Pichincha, Ecuador		289
US	1911510	M Acosta Solis	10322	7/16/1945	Pichincha, Ecuador		290
US	2882366	Ranti-Hitoa	18451	not given	Umbumba?, Peru (Peruviana)		291
US	2478553	T Meyer	3578	2/2/1941	Salta, Argentina		292
US	1547062	S Venturi	725	12/7/1919	Tucuman, Argentina	duplicate at SI no acc #	293
US	2540496	WR Ernst	1966	7/25/1965	Dominica, West Indies		294
US	2527692	RL Wilbur, EL Dunn, HA Hespenheide, DR Wiseman	8130	7/31/1964	Dominica, West Indies		295
US	2881248	SA Mori, RM King	12175	7/13/1979	Maracas, Brazil		296
US	2877053	GL Webster	13454	6/20/1965	Dominica, West Indies		297
US	2527712	RL Wilbur, EL Dunn, HA Hespenheide, DR Wiseman	7595	7/17/1964	Dominica, West Indies		298
US	2010579	not given	none	11/18/1949	Dominica, BWI		310
US	1547059	S Venturi	1974	1/17/1923	La Hoyata, Argentina		319
US	1816597	LR Parodi	13583	1/31/1940	Salta, Argentina		320
US	2183109	GJ Schwarz	9958	3/3/1950	Corrientes, Argentina		321
US	732153	Bro. Leon	4151	10/1913	Havana, Cuba		322
US	899532	T Rojas	133a	1906	Argentina	duplicate at US #899533	323
US	899533	T Rojas	133	1906	Argentina	duplicate at US #899532	324
US	2478525	JL Stephens, W Martlez	SH59	1/10/1948	Salta, Argentina		325

US	1914350	Jorgensen	1708	1915	Catamarca, Argentina		326
US	2544937	TM Pedersen	6998	4/2/1964	Corrientes, Argentina		327
US	3237026	PM Peterson, CR Annable, ME Poston	8921	4/24/1990	Azuay, Ecuador		328
US	2043785	CL Schulz	921	7/12/1946	Chaco, Argentina		329
US	2043782	CL Schulz	1150	1/28/1947	Chaco, Argentina		330
US	1194135	P Jorgensen	3099	4/1919	Formosa, Argentina		331
US	2076562	AA Beetle	H-S-559	4/20/1952	Cordoba, Argentina		332
US	1162574	E Hassler	12470	1913	Ypacaray, Paraguay		333
US	3214138	P Peterson, H Persaud	7448	6/13/1989	Demerara- Mahaica, Guyana		345
US	1868402	HH Bartlett	20592	7/7/1943	San Luis, Argentina		346
US	2153215	MR Malvarez	327	12/20/1946	Salta, Argentina	duplicate at MO #2312576	347
US	2856026	J Stroehlein, L Smith	none	8/16/1975	Tabaruela, Ecuador	duplicate at ARIZ #219807	350
US	899530	T Stuckert	12997	3/25/1903	Cordoba, Argentina		351
US	1063356	T? Rojas	2778 or 10711?	1/7/1917	Chaco, Paraguay		352
US	1762306	A Chase	12388	3/7/1940	Trujillo or Valera, Venezuela		353
US	922074	P Jorgensen	1708	2/3/1909?	Catamarca, Argentina		354
US	899528	T Stuckert	9167	3/31/1900	Cordoba, Argentina		355
US	2971074	ICA Saravia, Parada, Cuezoo	10039	4/9/1974	Salta, Argentina		356
US	2883853	C Quarin	2390	8/12/1974	Corrientes, Argentina		357
US	2014364	R Ferreyra	6876	2/12/1950	Huanuco, Peru		358
US	559929	Pere Duss?	1329	1880	Martinique		360

US	2686087	EC Tenorio	66-141	7/26/1966	de Pesquisas, Argentina?	389
US	1386872	S Venturi	7150	1/13/1928	Catamarca, Argentina	390
US	1386878	S Venturi	1980	1/3/1923	Tucuman, Argentina	391
US	1386876	S Venturi	1551	12/13/1921	Tucuman, Argentina	392
US	2462303	TM Pedersen	1747	10/6/1952	Corrientes, Argentina	393
US	2206987	E Asplund	10452	1/23/1940	Prov. Imbabura,?	405
US	726078	WE Hess	427	2/18/1914	Desechco, Porto Rico	408
US	905230	NL Britton, JF Cowell, S Brown	4689	2/27/1915	Punta Aguila, Porto Rico	409
US	1536473	HE Box	69	9/13/1931	Antiqua, British West Indies	410
US	726077	WE Heas	444	2/25/1914	Morra Island, Porto, Rico	411
US	1536450	HE Box	106	10/10/1931	Big Bird Island, Antiqua, British West Indies	412
US	1536460	HE Box	87	9/25/1931	Antiqua, British West Indies	413
US	1561889	JC Mutis	5548	1760-1808	Colombia	414
US	2116509	B Rosengurtt	5486	1/20/1949	Chaco, Paraguay	428
US	1441222	S Venturi	7822	12/27/1928	La Rioja, Argentina	437
US	1126620	Stuckert	5372	12/8/1898	Cordoba, Argentina	438
US	1012548	AC Jensen- Hoarui	05?	1905?	Santa Rosa, Mendoza, Argentina	439
US	1547060	S Venturi	2439	12/20/1923	Tucuman, Argentina	442
US	2010107	O Paci	820	2/3/1945	Mendoza, Argentina	447
US	1694841	MM Job	850	2/1/1936	Santa Fe, Argentina	448
US	2043845	J Semper	none	2/18-19/1944	San Luis, Argentina	449

US	2043948	A Rteuzzo	362	11/21/1945	San Juan, Argentina		451
US	899542	V Devyzati?	none	2/1904	LaRioja, Argentina		452
US	1160956	LR Parodi	4826	12/25/1922	Mendoza, Argentina		453
US	2746788	G Covas	454	1/23/1943	Mendoza, Argentina		454
US	3001821	A Burkart, Z Bacigalupo	21077	1/19/1960	E. Rios, Argentina	note on sheet: Ejemplar publicado en A Burkart, Fl. Illustr. Entre Rios. 2:208 1969; (Burkart identified specimen as <i>P mucronulatum</i> )	455
US	1865121	HH Bartlett	19436	1/22/1943	San Rafael, Mendoza, Argentina		458
US	2043959	J Brizuela	183	1/26/1947	Cataruarcas, Argentina		460
US	2182959	A Brizuela	478	1946	Cotomorca, Argentina		461
US	2075024	Jorgensen	1355	1915	Catamarca, Argentina	duplicate at US #2075036	462
US	2075036	Jorgensen	1355	1915	Catamarca, Argentina	duplicate at US #2075024	463
US	1865070	HH Bartlett	20145	3/1-21/1943	Cordoba, Argentina		464
US	2079346	H Sleumer, F Vervoorst	2328	1/22/1952	Catamarca, Argentina		471
US	2010046	LO Melis, O Paci	288	12/12/1949	Madoza, Argentina		472
US	1162325	Fries	804	11/20/1901	Jryiuy, Huancar, Argentina	designated as a type collection of <i>P. ceasptosum</i> ; Fries. 1905. Nova Cxta Regia Soc Sci Upsal. IV 1:177, pl 9 fig 5-6	1
US	899538	Arechavaleta	none	not given	Uruguay	note from Reeder, 1988 on sheet stating that this may be part of type collection of <i>P. subbulbosum</i>	2
US	2010484	M. Acosta-Solis	14838	12/29/1949	Imbabura, Ecuador		151
US	2882365	Raula-Hirsch	1367	5/27/1954	Alpuinval, Peru		149
US	2010512	M. Acosta-Solis	16298	3/5/1950	Pichincha, Ecuador		147

US	1876154	T Goodspeed, A Weberbauer	33070	3/15-22/1942	Huarochiri, Peru		146
US	2463851	HS McKee	10541	8/7/1963	Guadeloupe, Vieux Fort, West Indies		114
US	3001831	A Burkart	23235	3/14/1962	San Isidro, Argentina		113
US	899529	T Stuckert	11262	4/6/1902	Cordoba, Argentina		111
US	899527	Sabzmann	none	1918	Bahia, Brazil		148
US	987481	H Pittier	7360	9/2/1917	Cotiza, Caracas, Venezuela		543
US	1065277	H Pillier	8888	6/22/1920	Carabobo, Venezuela		554
US	1447292	DB Tickel	2331	2/12/1930	Pernambuco, Brazil		556
US	1798698	J Cuatrecasas, HG Barriga	9830	7/18/1940	Boyaca, Colombia		557
US	1858483	H Pittier	15152	9/1943	Venezuela		542
US	1388623	DB Pickel	1567	5/1928	Pernambuco, Brazil		562
US	1447504	S Juzepozuk	4731	5/7/1926	Colombia		560
US	1067254	H Pittier	9057	8/12/1920	Carabobo, Venezuela		561
US	2011558	G Pinto	0210	10/1949	Bahia, Brazil		558
US	1535766	DB Pickel	23311/2	2/12/1930	Pernambuco, Brazil		559
US	1108178	LH Bailey, EZ Bailey	49	12/20/1921	Caracas, Venezuela	duplicate? at BH no acc #; this specimen has a different collection date, but the collector and collection number is the same; see OTU-541	553
US	1257300	A Chase	7815	11/29- 30/1924	Paulo Affonso Falls, Alagoas, Brazil	duplicates at F #561315 & MO #924265	551
US	1694805	H Pittier	13693	7/1936	Ingomar, Turmerito, Venezuela		534
US	1613323	JR Swallen	4364	4/17/1934	Crato to Barbalha, Ceara, Brazil		552
US	2182968	FE Luna	696	2/13/1948	Salta, Tucuman, Argentina		482

US	1865699	LR Parodi	14618	2/9/1943	Fumboya, Argentina		510
US	2075050	E Budin	13347	12/13/1906	Formosa, Argentina		615
US	1127746	LR Parodi	88	12/1921	La Plata, Argentina		518
US	704210	W Fischer	43	12/25/1914	Rio Negro Valley, General Roca, Argentina		517
US	1910129	Rosengurtt	B-4924	11/30/1945	Paysandu, Uruguay		515
US	1865848	WJ Eyerdam, AA Beetle, E Grondona	23508	12/16/1938	Buenos Aires, Argentina		514
US	3001822	A Burkart	17775	12/21/1948	San Isidro, Argentina		512
US	2043935	CA O'Donell Meyer	12603	3/12/1947	Coloniorca, Argentina		511
US	2951793	Rosengurtt	B-6720	10/28/1957	Rio Negro, Uruguay		509
US	1445335	T Schroun	19553S	11/13- 18/1924	Sorano, Uruguay		508
US	2306895	NM Bacigalupo	20633	12/1/1959	La Pampa, Argentina		531
US	2043836	Krapovickas	2588	12/14/1945	Buenos Aires, Argentina		530
US	899537	T Stuckert	11	2/1902	Cordoba, Argentina		529
US	1865717	Rosengurtt	B-4593	2/29/1944	Paysandu, Uruguay	duplicate at US #1865716	528
US	1564037	Krapovickas	2619	10/28/1945	Buenos Aires, Argentina	duplicate at MO #1300514	525
US	1865716	Rosengurtt	B-4593 1/2	2/29/1944	Paysandu, Uruguay	duplicate at US #1865717	524
US	1160957	LR Parodi	4841	12/25/1922	Mendoza, Argentina		614
US	2911943	B Balegno	768	11/25/1946	Santa Fe, Argentina		633
US	1865142	HH Bartlett	19603	2/5/1943	Catamarca, Argentina		632
US	1816123	Budui	none	2/1931	Jujuy, Argentina		635
US	1163276	H Niedfela	39	4/22/1923	Saladillo, Argentina		631

US	1815763	LR Parodi	14207	2/4/1941	Catamarca, Argentina		629
US	1012554	ACJ Haarcop?	none	12/1904	Mendoza, Argentina		627
US	2432209	DS Correll, KS Dodds, EH Brucher, G Paxman	A 671	2/25/1960	Jujuy, Argentina		625
US	1547061	S Ventuui	566	10/20/1919	Chauas, Artentina		624
US	2931016	SA Renvoize, TA Cope, S Beck	4065	3/24/1981	Santa Cruz, Florida, USA	duplicate at MO #3040565	591
US	2010089	AR Leal, O Paci	488	11/27/1949	Mendoza, Argentina		589
US	2010119	FA Barkley	19AR80 2	12/20/1949	Mendoza, Argentina		588
US	899534	RE Fries	804	1/11/1920	Argentina	note on sheet : "type call"	587
US	950637	Lofgreu?	3754	3/1912	Bahia?		144
US	965869	Salzmann	none	not given	Bahia?		271
US	2043783	CL Schulz	914	12/12/1946	Chaco, Argentina?		507
US	1815027	Rosengurtt	B-3238	2/21/1941	Paysandu, Uruguay		533
US	1910321	HH Bartlett	19743	3/23/1943	Santiago, Artentina		109
US	1816049	Schreiter	4497	12/30/1925	Tucuman, Argentina		118
US	1257302	A Chase	7767	11/21/1924	Pina to Boa Viagern, Brazil	duplicate at MO #924264	168
US	2306895	Bacigalupo	20633	12/1/1959	La Pampa, Argentina		531
US	1816051	Schreiter	4501	12/30/1925	Cucuman, Argentina		233
US	2043784	CL Schulz	1339	2/18/1947	Tucuman, Argentina		481
US	2627400	Rosengurtt	B-5843	2/25/1950	Paraguay	inflorescence absent on this specimen, duplicate at US has inflorescence; duplicate at US #2951792	132
US	899543	Nutall?, Capt. Wilkes?	none	1838-1842	Rio Negro, N. Patagonia		522
US	1911619	Itrie	2	3/30/1942	La Pampa, Argentina		584



US	2153201	A Reales	1971	3/20/1949	Catamarca, Argentina	585
US	1721044	A Castellanos	89	2/8/1919	Cordoba, Argentina	586
US	1421817	S Venturi	1980	1/3/1923	Rio Sali, Argentina	592
US	1421813	S Venturi	1068	11/28/1920	Tucuman, Argentina	501
US	1161436	RE Fries	1099	1/2/1916	Tarijra, Bolivia	595
US	1816023	Schreiter	45666	3/1939	Catamarca, Argentina	634
US	2461674	Rosengurt	B-7617	12/5/1958	Cordoba, Argentina	142
US	2184553	EP Killip	39557	10/20/1948	Salta, Argentina	628
US	899541	T Stuckert	11259	1/1902	Cordoba, Argentina	513
US	556980	T Stuckert	238	11/9/1900	San Teodoro, Argentina?	532
US	1298029	LR Parodi	7488	12/1-4/1926	Cordoba, Argentina	167
US	1910318	HH Bartlett	19739	3/23/1943	Argentina	127
US	2437116	E Carette	none	1916	Mendoza, Argentina	178
US	2010009	MR Caceres	46	11/27/1949	Mendoza, Argentina	180
US	2010135	LO Melis, FA Barkley	none	4/19/1978	Mendoza, Argentina	179
US	2462240	TM Pedersen	1350	2/26/1951	Corrientes, Argentina	183
US	2116496	Rosengurt	B-5429	1/17/1949	Asuncion, Paraguay	128
US	2900535	J Brizuela	461	1/14/1950	Catamarca, Argentina	182
US	1815985	Lillo	4853	2/18/1906	Tucuman, Argentina	184
US	1539760	Lahiffy, Castro	11	3/1933	La Rioja, Argentina	186
US	2010004	MR Caceres	22	12/2/1949	Mendoza, Argentina	185
US	2012859	E Anderson	1177	3/25/1950	Chaco, Paraguay	188

US	1724928	S Venturi	639	12/1919	Tucuman, Argentina		189
US	1063353	Rojas	2775 or 10835	2/28/1917	Trinidad, Asuncion, Paraguay		190
US	1690779	WA Archer	4940	1/9/1937	Campo Grande, Jardin Botanico, Paraguay		129
US	2931014	SA Renvoize, TA Cope	4225	6/4/1981	La Paz, Bolivia		141
US	1645117	not given	none	not given	not given		143
US	899540	T Stuckert	20052	5/5/1909	not given		121
US	921902	P Jorgensen	none	5/1/1917 or 1/5/1917	Catamarca, Argentina		120
US	1111787	P Jorgensen	1355	2/20/1915	Catamarca, Argentina		119
US	1936132	W Hartley	SH-131	2/18/1948	Puerto Casado, Paraguay		117
US	294585	OL Lorendr, G Hieronymus	346	2/1823	Salla, Argentina		126
US	1474770	E Wilczek	536	1-2/1897	Mendoza, Argentina		450
US	1760276	Rodriquez	248	12/28/1911	Tucuman, Argentina		187
US	2478526	W Martley, T Rojas	SH-190	2/28/1948	Asuncion, Paraguay		441
US	2461316	TM Pedersen	3722	1/29/1956	Corrientes, Argentina		622
US	1385979	LR Parodi	8459	1/25/1928	Formosa, Argentina		581
US	2478552	WA Archer	4940	1/9/1937	Campo Grande, Jardin Botanico, Paraguay		440
US	1936151	W Hartley, T Rojas	SH-190	2/28/1948	Asuncion, Paraguay		459
US	1816086	Rodriquez	248	12/28/1911	Tucuman, Argentina	duplicate at US #1724187	465
US	1724187	Rodriquez	248	12/28/1911	Tucuman, Argentina	duplicate at US #1816086	418
US	2010060	LO Melis, C Cherubini, O Paci	569	10/17/1949	Mendoza, Argentina		181
US	1257301	A Chase	7872	12/8/1924	Amarillinho, Brazil		623

US	1447506	G Woronow, S Juzepczuk	4906	5/1926	Beltran, Colombia	555
US	1819167	Rosengurtt	B-4113	10/22- 23/1942	Rio Negro, Uruguay	516
US	1055371	RE Fries	1099	1/2/1916	Farija, Bolivia	177
US	1910116	RL Parodi	14845	2/16/1944	La Rioja, Argentina	590
US	899539	T Stuckert	10213	11/21/1901	Cordoba, Argentina	626
US	1160955	LR Parodi	4876	12/25/1922	Mendoza, Argentina	630
US	2379786	H Ellenberg	2206	8/7/1957	Huanuco, Peru	152
US	600930	HH Smith	2536	1898-1899	Santa Marga, Colombia	150
US	824093	Thomas	112	12/1882	Indiae Occidentalis	169
US	2931015	SA Renvoize, TA Cope	4226	6/4/1981	Bolivia	125
US	1564499	M Cardenas	2452	3/1944	Bolivia	153
US	2444348	H Steble	2079	9/10/1937	La Martinique?	110
US	899523	not given	none	not given	Trinidad	136
US	2241435	OV Nunez	2542	2/16/1950	Huanuco, Peru	135
US	1108510	EWD Holway, MM Holway	367	3/4/1920	Cochrabaruba, Bolivia	112
US	899525	WE Hess	1607	5/31/1913	Puerto Rico	225
US	none	Gardner	2337	not given	Prauby, Brazil	170
US	899522	not given	none	not given	Havana, Cuba	171
US	1936127	W Hartley	SH-121	2/18/1948	Puerto Casado, Paraguay	106
US	1645118	not given	none	not given	Bahia	154

## APPENDIX F

Data Sheet used to record 151 morphological features  
of each specimen of *Pappophorum*.

OTU \_\_\_\_\_

Species \_\_\_\_\_

Synonyms \_\_\_\_\_

\_\_\_\_\_

Species (as identif. on herbarium sheet)

\_\_\_\_\_

\_\_\_\_\_

Country \_\_\_\_\_

Collection Date \_\_\_\_\_

Herbarium \_\_\_\_\_

Herbarium Accession No. \_\_\_\_\_

\_\_\_\_\_

Collector/Accession No. \_\_\_\_\_

\_\_\_\_\_

List of Characters	DATA
culm height (cm)	
<b>nodes-constrict.</b> (1) const. 2) swollen 3) = to internode	

<b>nodes - color</b> (1) dark brn. (2) stramineous (3) yellow brn. (4) purple	
<b>nodes - glands</b> (1) + (2) -	
<b>nodes - glands</b> (1) at (2) Abv (3) Below (4) both A&B	
<b>nodes-glands</b> (1) sparse (2) mod. abundant (3) abundant	
<b>nodes-indum.</b> (1) glab. (2) scabr. (3) pubes (4) puberul.	
<b>internodes</b> (1) solid (2) hollow	
<b>internodes-glands</b> (1) + (2) -	
<b>internodes-glands</b> (1) sparse (2) mod. abundant (3) abundant	
<b>internodes -indum</b> (1) glab. (2) scabr. (3) pubes (4) puberul. (5) pilose	
<b>sheaths</b> (1) longer (2) equal to (3) shorter than internode	
<b>sheaths-glands</b> (1)+ (2) -	
<b>sheaths-glands</b> (1) sparse (2) mod. abundant (3) abundant	
<b>sheaths</b> (1)glands restr. to margins (2) uniform	
<b>sheaths -indum</b> (1) glab. (2) scabr. (3) pubes 4) puberul. (5) pilose	
<b>sheaths-margins</b> (1) entire (2) scabrous (3) puberulent (4) scabr and puberul (5) pilose (6) pilose & scab	
<b>ligule length (mm)</b>	
<b>ligule - sets:</b> 1)one 2) two	

<b>collar - constr.</b> (1) + (2) -	
<b>collar-color</b> (1) stramin (2) brown (3) purple (4) purp&stra	
<b>collar-indum.</b> (1) glab. (2) scabr. (3) pubes (4) puberul. (5) pilose	
<b>collar hair length (mm)</b>	
<b>blades</b> (1) narrow (<10 mm) (2) broad (>10 mm)	
<b>blade width (mm)</b>	
<b>blade length (cm)</b>	
<b>blade -adaxial-glands</b> (1) + (2) -	
<b>blade-adaxial-glands</b> (1) sparse (2) mod. abundant (3) abundant	
<b>blade -adaxial-indum</b> (1) glab. (2) scabr. (3) pubes (4) puberul. 5) pilose	
<b>blade -abaxial-glands</b> (1) + (2) -	
<b>blade-abaxial -glands</b> (1) sparse (2) mod. abundant (3) abundant	
<b>blade -abaxial-indum</b> (1) glab. (2) scabr. (3) pubes (4) puberul. 5) pilose	
<b>blade -margins-glands</b> (1) + (2) -	
<b>blade-margins-glands</b> (1) sparse (2) mod. abundant (3) abundant	
<b>blade -margins</b> (1) entire (2) scab (3) puberul (4) scabro & puberul	
<b>blade -flaring at base</b> (1) + (2) -	
<b>blade-flaring at base</b> (1) glabrous (2) pubescent	
<b>inflor.- overall shape</b> (1) elliptic (2) oblong/ovate (3) lanceolate (4) rhombic (5) trullate (6) obtrullate (7) triangular (8) cuneate	
<b>inflor. length (cm)</b>	
<b>inflor. width (cm)</b>	
<b>inflor. lgth/wdth ratio</b>	

<b>peduncles length (cm)</b>	
<b>peduncles -glands</b> (1) + (2) -	
<b>peduncles-glands</b> (1) sparse (2) mod. abundant (3) abundant	
<b>peduncles- indum</b> (1) glab. (2) scabr. (3) pubes (4) puberul. 5) pilose	
<b>peduncles-inserted in sheath</b> (1) + (2) -	
<b>central axes- term in spikelet</b> (1) + (2) - (3) un det	
<b>central axes -</b> (1) capillary (2) slender (3) stout	
<b>central axes - width (mm)</b>	
<b>central axes - glands</b> (1) + (2) -	
<b>central axes-glands</b> (1) sparse (2) mod. abundant (3) abundant	
<b>central axes - indum</b> (1) glab. (2) scabr. (3) pubes (4) puberul. (5) scab. & pubes.	
<b>branches -# per node</b>	
<b>branches- term in spikelet</b> (1) + (2) -	
<b>branches -habit</b> (1) appressed (2) reflexed	
<b>branches</b> (1) capillary (2) slender (3) stout	
<b>branches width (mm)</b>	
<b>branches length (mm)</b>	
<b>branches - glands</b> (1) + (2) -	
<b>branches-glands</b> (1) sparse (2) mod. abundant (3) abundant	
<b>branches-indum</b> (1) glab. (2) scabr. (3) pubes (4) puberul.	
<b>pedicels # per node</b>	
<b>pedicels - habit</b> (1) appressed (2) reflexed	
<b>pedicels</b> (1) capillary (2) slender (3) stout	
<b>pedicels width (mm)</b>	
<b>pedicels -</b> (1) equal 2) unequal to each other	
<b>pedicels - If equal:</b> (1) shorter 2) equal (3) longer than spikelet	

<b>pedicels</b> length (mm) if equal	
<b>pedicels- glands</b> (1) + (2) -	
<b>pedicels-glands</b> (1) sparse (2) mod. abundant (3) abundant	
<b>pedicels-indum</b> (1) glab. (2) scabr. (3) pubes (4) puberul.	
<b>spikelet</b> length (mm)	
<b>spikelet</b> width (mm)	
<b>floret-shape</b> (1) ovate (2) obovate (3) oblong (4) elliptic	
<b>floret- #</b> per spikelet	
<b>floret- #</b> fertile	
<b>floret- #</b> sterile	
<b>floret- length</b> (mm) (length of lowest or 1st floret)	
<b>callus - indum</b> (1) glabr (2) < 1/2 lngth of floret body (3) > 1/2 lngth of floret body	
<b>glumes</b> (1) equal (2) sub equal (3) unequal in length	
<b>glumes</b> (1) both longer than floret bodies (2) both shorter (3) one shorter and one longer than floret bodies	
<b>glumes-LOWER-apex</b> (1) bifid (2) entire (3) eros	
<b>glumes-LOWER-midnerve</b> extending as awn (1) + (2) -	
<b>glumes-LOWER- length</b> of awn/mucro (mm)	
<b>glumes-LOWER-</b> length (mm)	
<b>glumes-LOWER-</b> width (mm)	
<b>glumes-LOWER-shape</b> (1) ovate (2) obovate (3) oblong (4) elliptic (5) lanceolate	
<b>glumes-LOWER-indum -</b> <u>body</u> (1) glab. (2) scabr. (3) pubes (4) puberul.	
<b>glumes-LOWER-indum -</b> <u>midnerve</u> (1) glab. (2) scabr. (3) pubes (4) puberul.	
<b>glumes-LOWER-indum -</b> <u>awn</u> (1) glab. (2) scabr. (3) pubes (4) puberul.	

<b>glumes-LOWER-glands</b> (outer surf.) (1) + (2) -	
<b>glumes-LOWER-glands</b> (outer surf.) (1)midnerve only, (2) body only (3) midnerve & body	
<b>glumes-LOWER-glands</b> (outer surf.) (1) sparse (2) mod. abundant (3) abundant	
<b>glumes-LOWER-glands</b> (inner surf.) (1) + (2) -	
<b>glumes-LOWER-glands</b> (inner surf.) (1) sparse (2) mod. abundant (3) abundant	
<b>glumes-LOWER-glands</b> awn (1) + (2) -	
<b>glumes-UPPER-apex</b> (1) bifid (2) entire (3) eros	
<b>glumes-UPPER-midnerve</b> extending as awn (1) + (2) -	
<b>glumes-UPPER- length</b> of awn/mucro (mm)	
<b>glumes-UPPER-</b> length (mm)	
<b>glumes-UPPER-</b> width (mm)	
<b>glumes-UPPER-shape</b> (1) ovate (2) obovate (3) oblong (4) elliptic (5) lanceolate	
<b>glumes-UPPER-indum -</b> <u>body</u> (1) glab. (2) scabr. (3) pubes (4) puberul.	
<b>glumes-LOWER-indum -</b> <u>midnerve</u> (1) glab. (2) scabr. (3) pubes (4) puberul.	
<b>glumes-UPPER-indum -</b> <u>awn</u> (1) glab. (2) scabr. (3) pubes (4) puberul.	
<b>glumes-UPPER-glands</b> (outer surf.) (1) + (2) -	
<b>glumes-UPPER - glands</b> (outer surf.) (1)midnerve only, (2) body only (3) midnerve & body	
<b>glumes-UPPER-glands</b> (outer surf.) (1) sparse (2) mod. abundant (3) abundant	
<b>glumes-UPPER-glands</b> (inner surf.) (1) + (2) -	
<b>glumes-UPPER-glands</b> (inner surf.) (1) sparse (2) mod. abundant (3) abundant	
<b>glumes-UPPER-glands</b> awn (1) + (2) -	

<b>lemma-shape</b> (1) ovate (2) obovate (3) oblong (4) elliptic	
<b>lemma-awn lgth (mm)</b>	
<b>lemma-body lgth (mm)</b>	
<b>lemma awn/body ratio</b>	
<b>lemma-body wdth (mm)</b>	
<b>lemma-(outer)-glands</b> (1) + (2) -	
<b>lemma-(outer)-glands</b> (1) sparse (2) mod. abundant (3) abundant	
<b>lemma-(inner)-glands</b> (1) + (2) -	
<b>lemma-(inner)-glands</b> (1) sparse (2) mod. abundant (3) abundant	
<b>lemma-awns-glands</b> (1)+ (2) -	
<b>lemma-awns-glands</b> (1) sparse (2) mod. abundant (3) abundant	
<b>lemma-nerve #</b>	
<b>lemma-awn #</b>	
<b>lemma-awn-color</b> (1) tawny (2) purple	
<b>lemma-awns-appear.</b> (1) capillary (2) slender (3) stout	
<b>lemma-(outer)-indum</b> (1) glab. (2) scabr. (3) pubes (4) puberul.	
<b>lemma-(outer)-where</b> indum (1) extend. <1/2 lgth lemma body (2) >1/2 lgth lemma body (3) from base to apex	
<b>lemma-(inner)-indum</b> (1) glab. (2) scabr. (3) pubes (4) puberul.	
<b>lemma-(inner)-where</b> indum (1) apex only (2) from base to apex, conc at apex (3) from b to a, uniform	
<b>palea-enclosed in lemma</b> (1) + (2) -	
<b>palea-indum. - nerves</b> (1) glab. (2) scabr. (3) pubes (4) puberul. (5) pilose	
<b>palea-indum. - body</b> (1) glab. (2) scabr. (3) pubes (4) puberul. (5) pilose	
<b>palea-nerves-glands</b> (1) + (2) -	
<b>palea-apex</b> (1) eros (2) awned (3) both	
<b>palea-awn #</b>	

<b>palea-shape</b> (1) ovate (2) obovate (3) oblong (4) elliptic (5) lanceolate	
<b>palea-length (mm)</b>	
<b>palea-width (mm)</b>	
<b>rachilla-term in floret</b> (1) + (2) -	
<b>rachilla-glands</b> (1) + (2) -	
<b>stamen-anther lgth</b> (mm)	
<b>stamen-anther shape</b> (1) oblong (2) globose	
<b>stamen-anther -color</b> (1) yellow (2) brown (3) orange (4) purple (5) rust	
<b>stamen #</b>	
<b>stigma-color</b> (1) yellow (2) brn (3) orange (4) red (5) purp (6) white	
<b>caryopsis-shape</b> (1) oblong (2) ovate (3) obovate (4) elliptic	
<b>caryopsis-length (mm)</b>	
<b>caryopsis-width (mm)</b>	
<b>caryopsis-color</b> (1) brown (2) yellow-brn (3) red-brn (4) tan (5) golden-yellow	
<b>caryopsis-texture</b> (1) smooth (2) rugose (3) pitted	

NOTES:

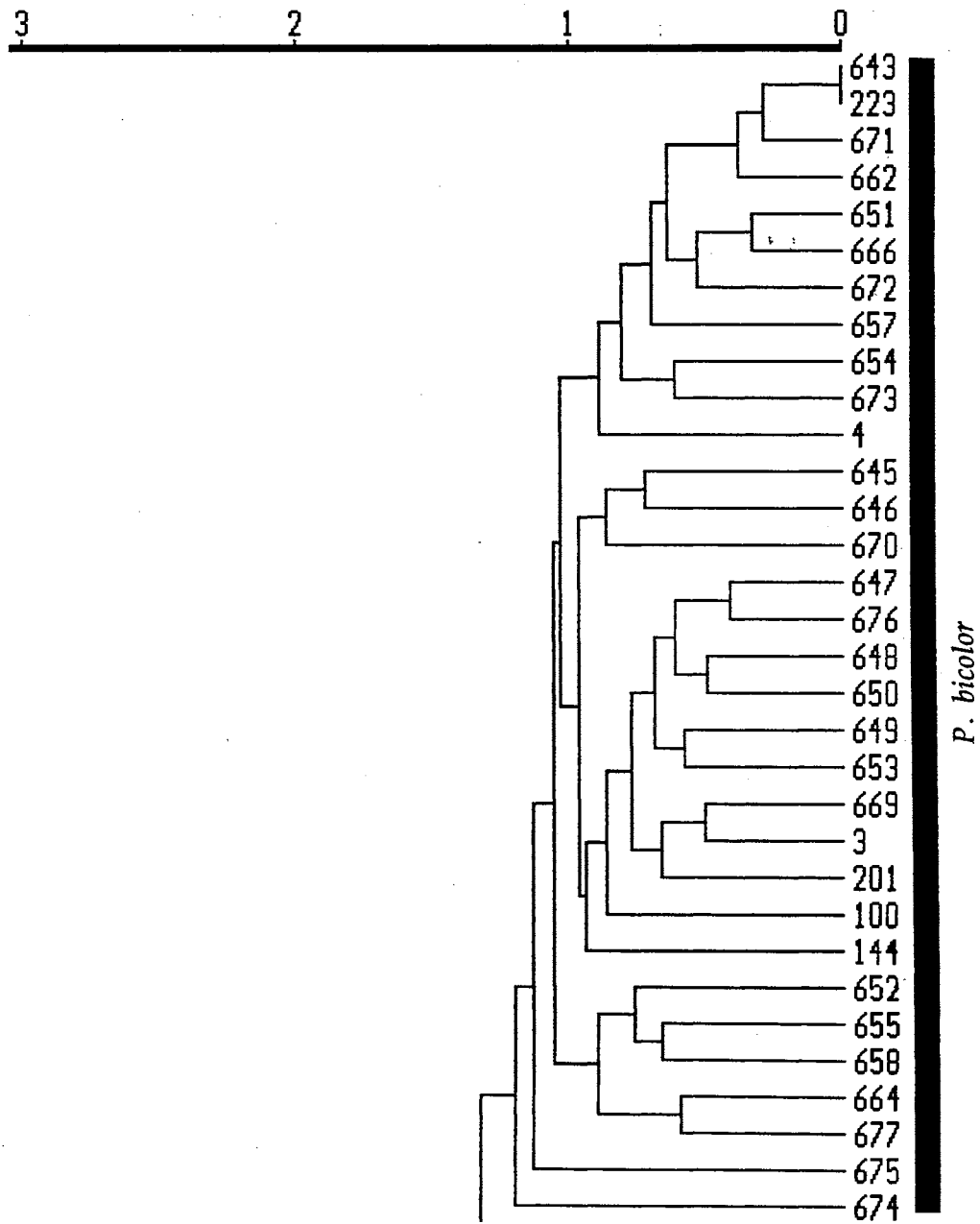
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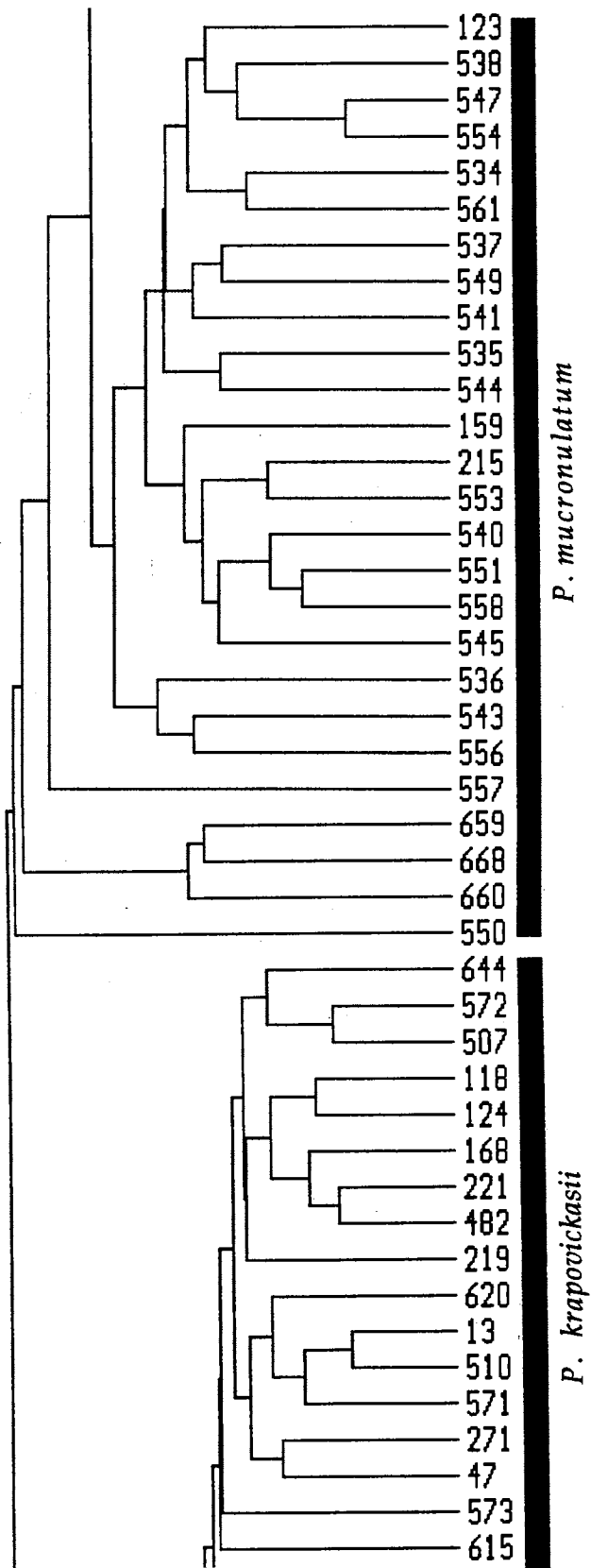
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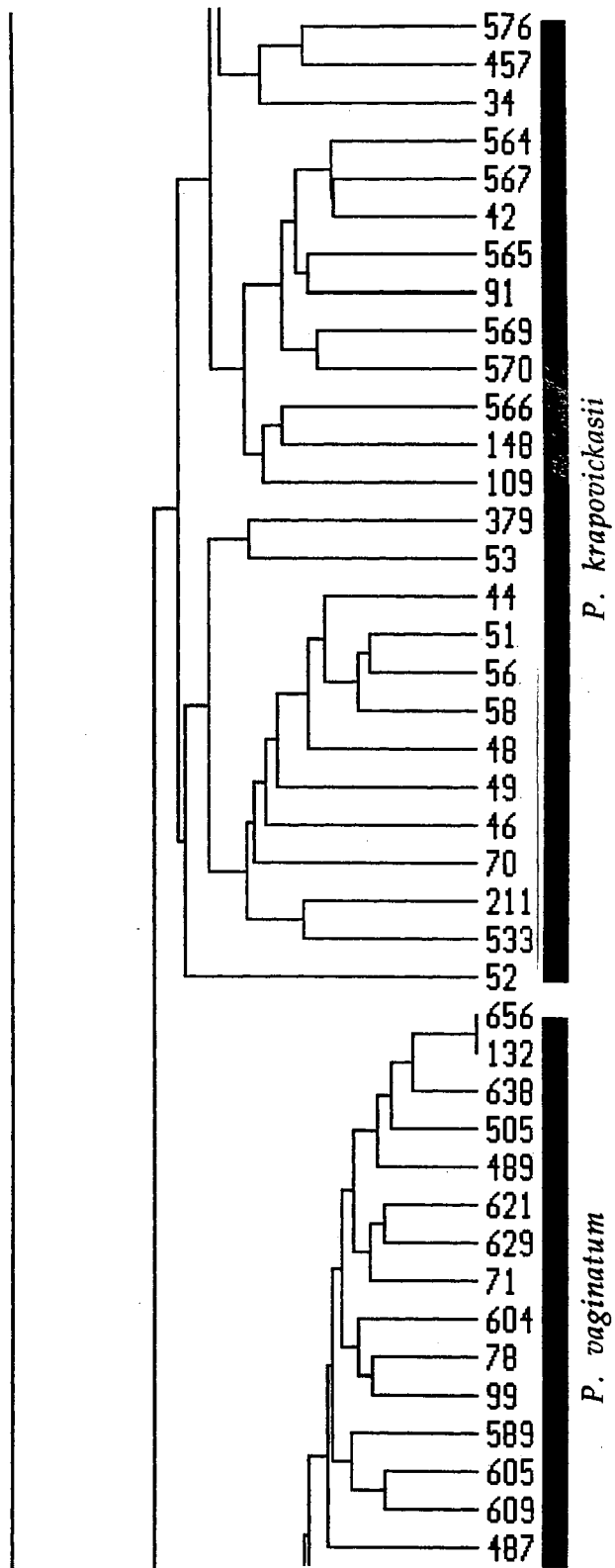
# APPENDIX G

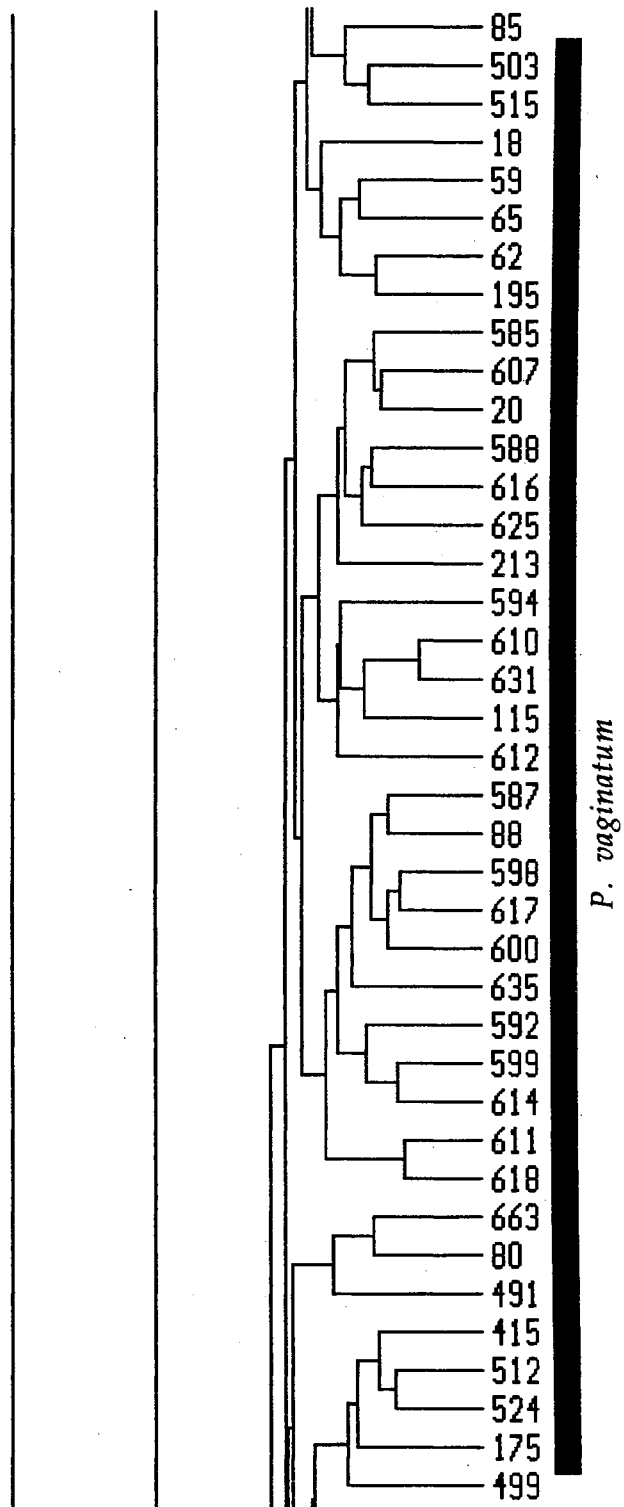
Phenogram resulting from NT-SYS analysis of  
*Pappophorum* (51 characters by 676 OTUs).

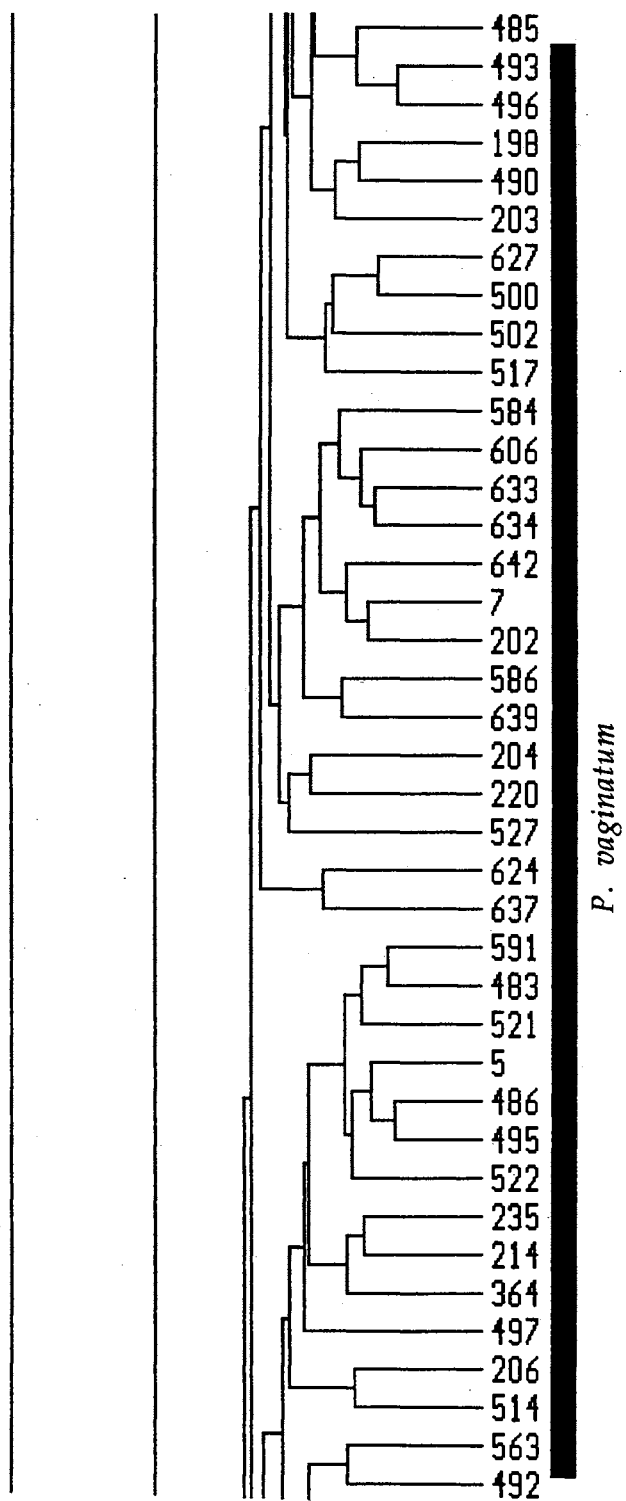


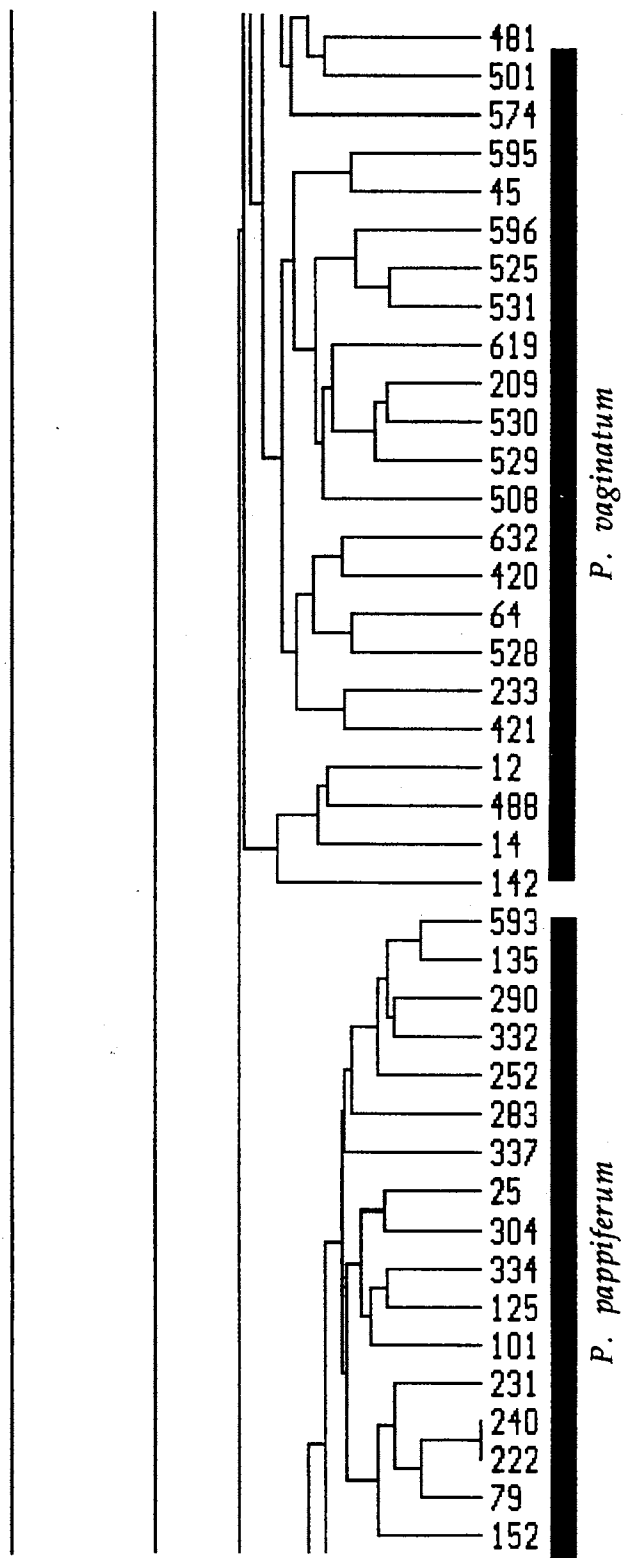


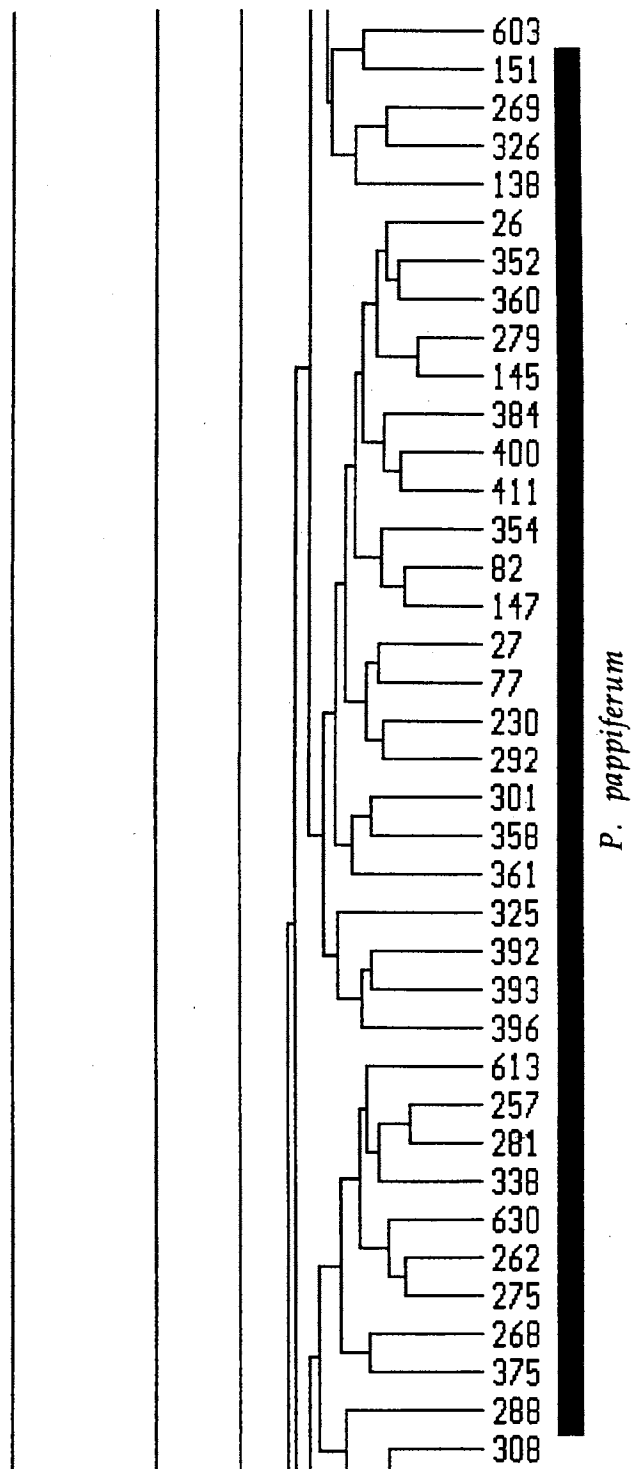


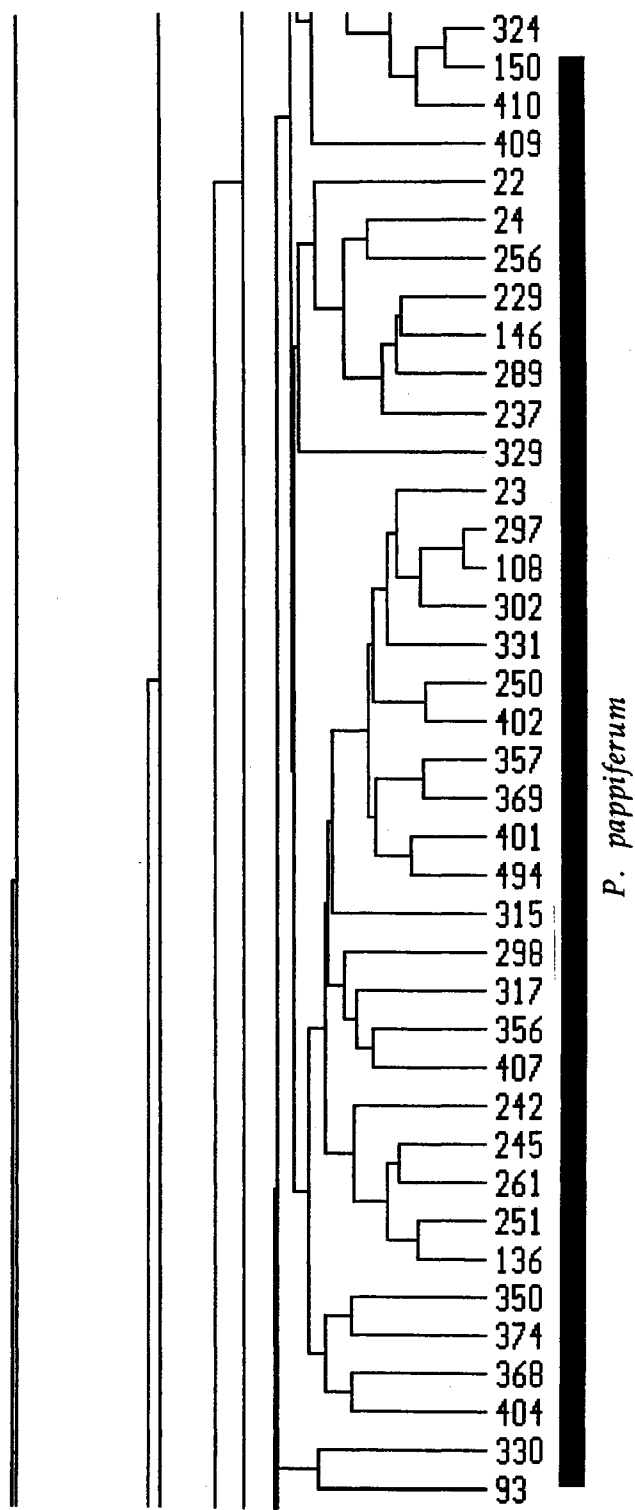


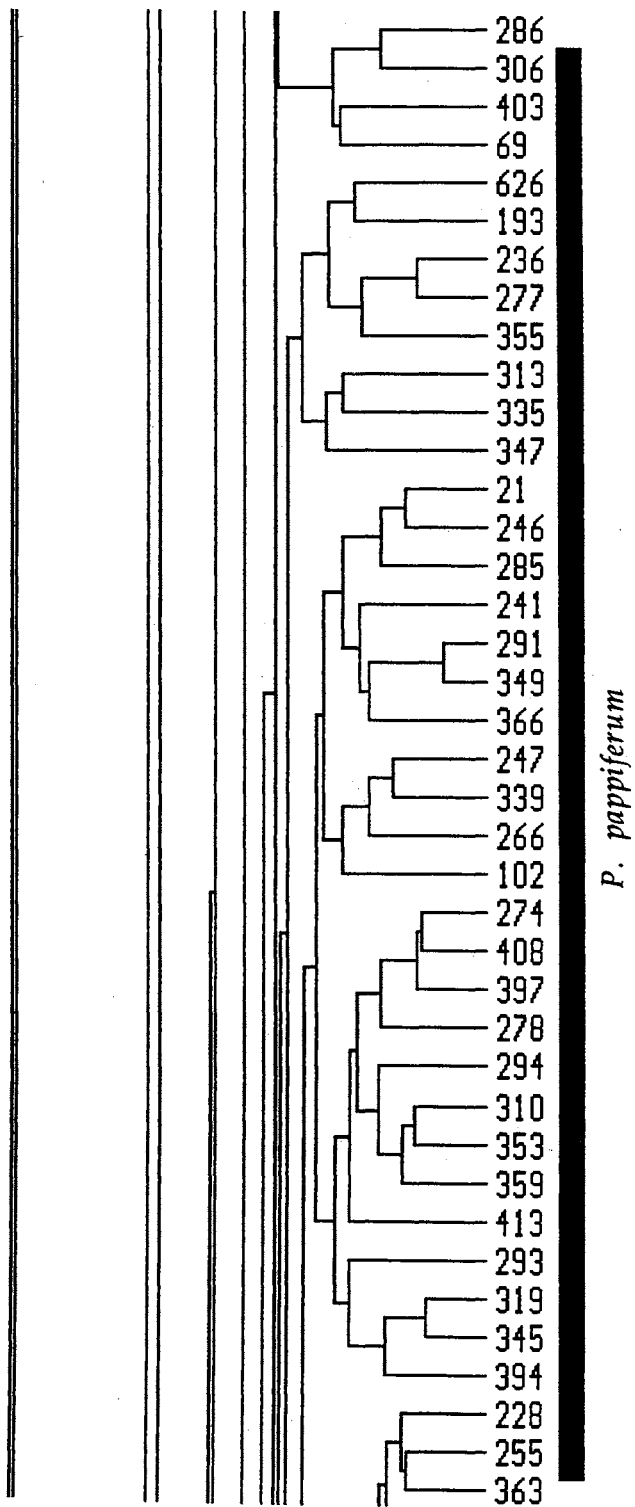




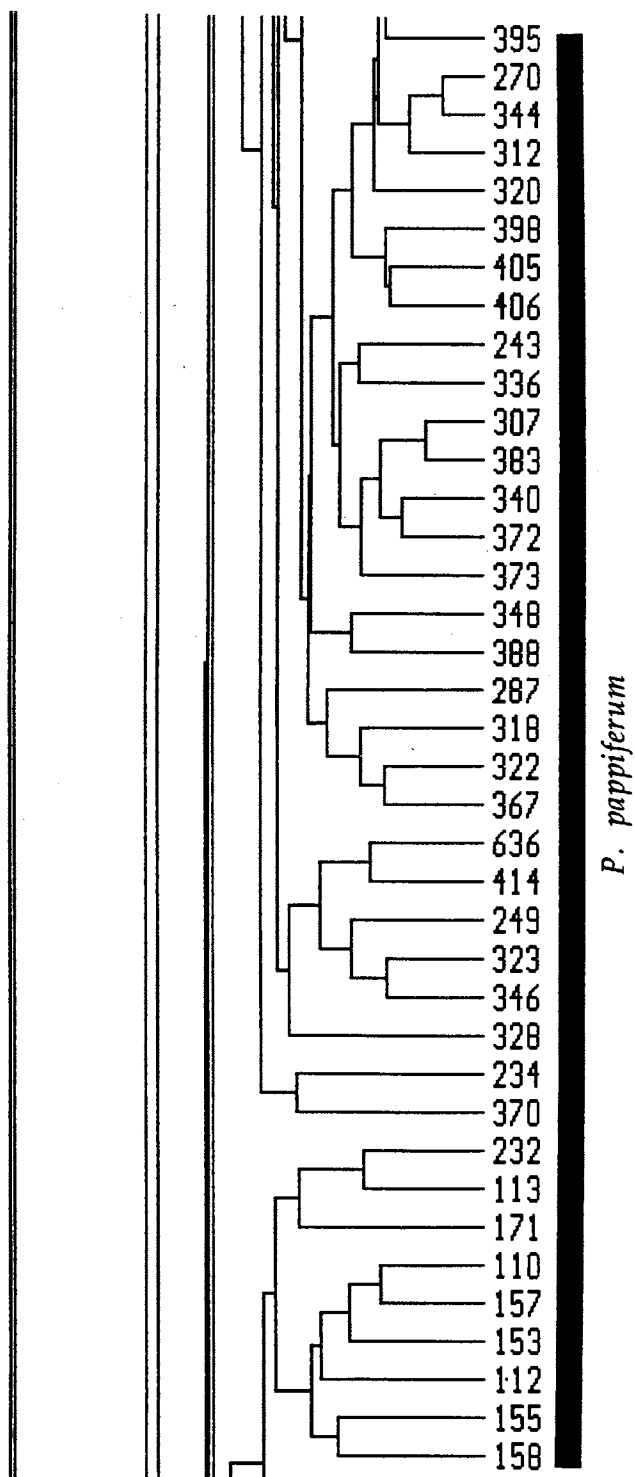


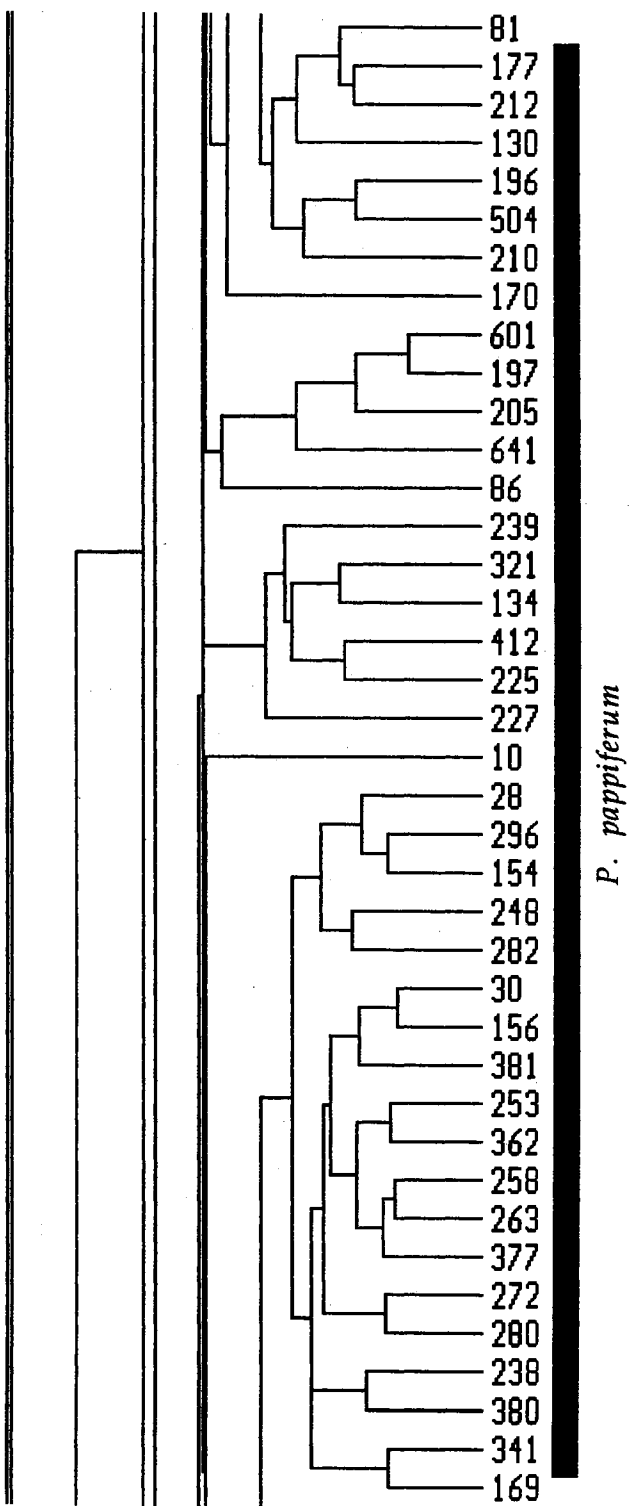


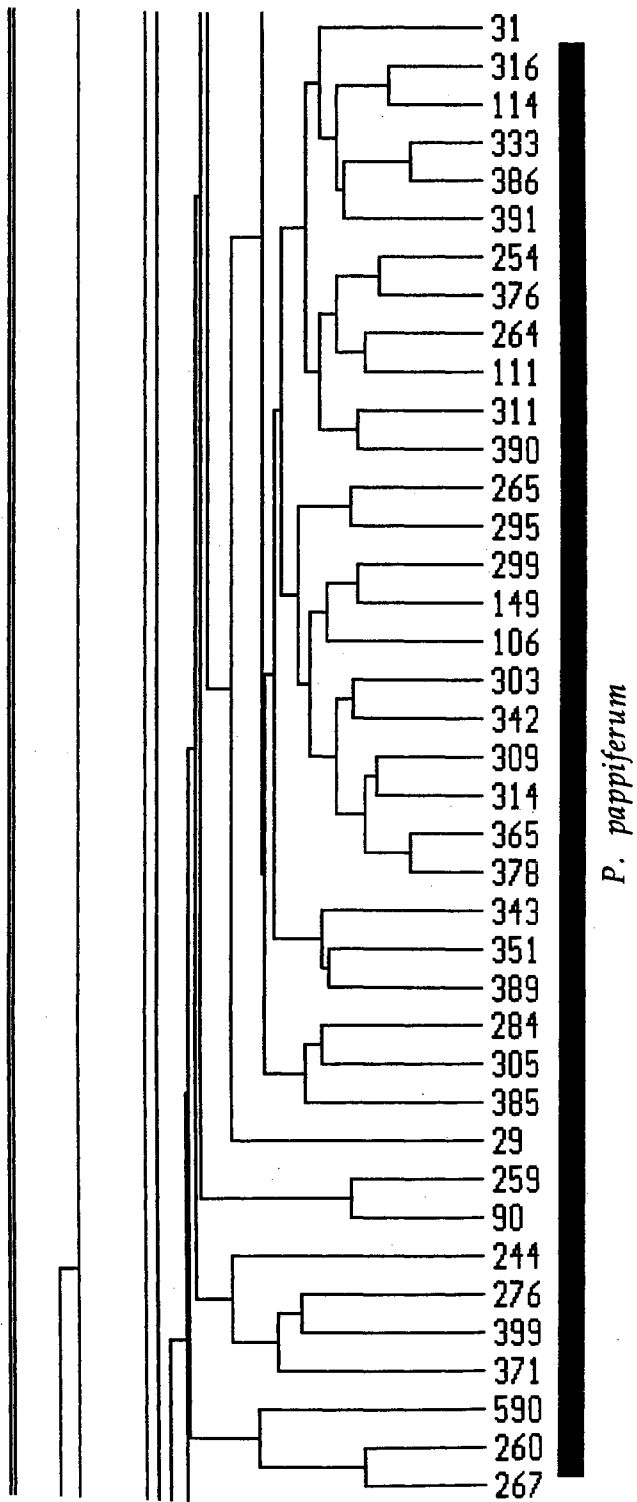


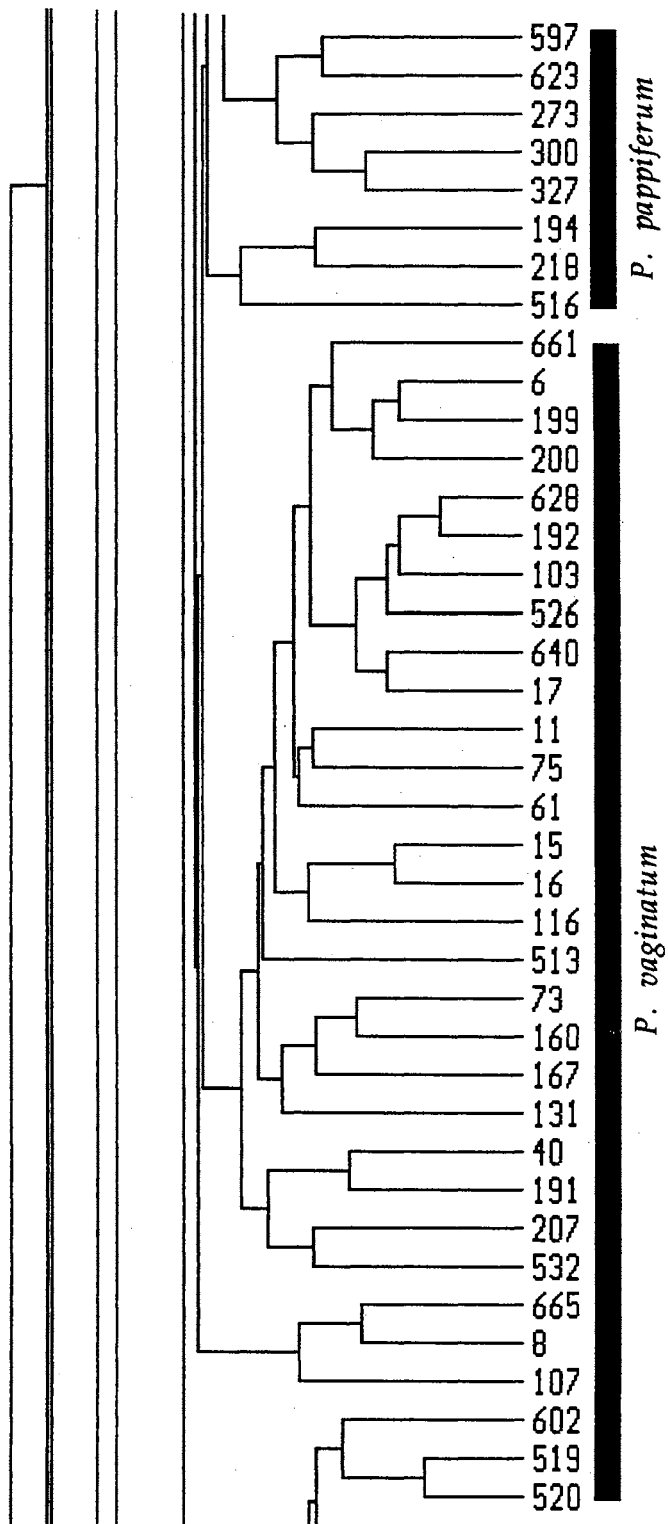


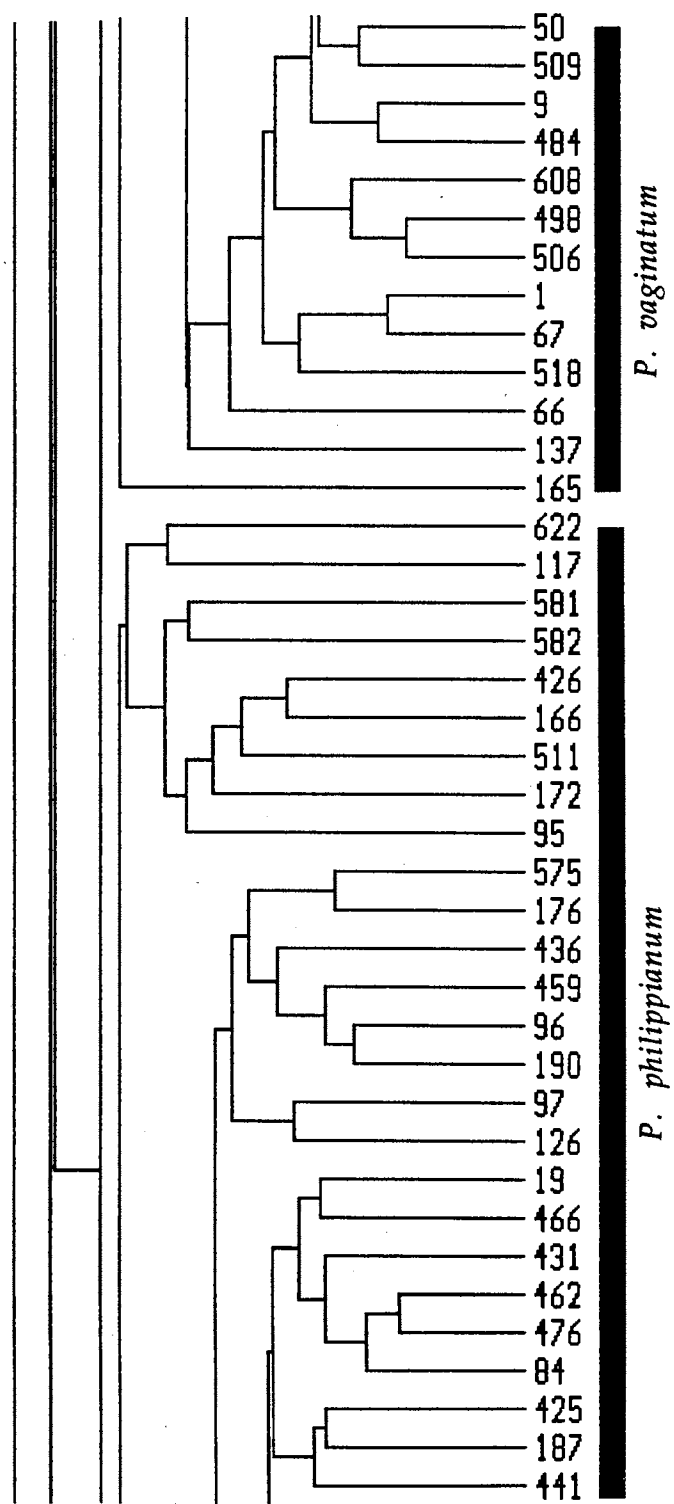


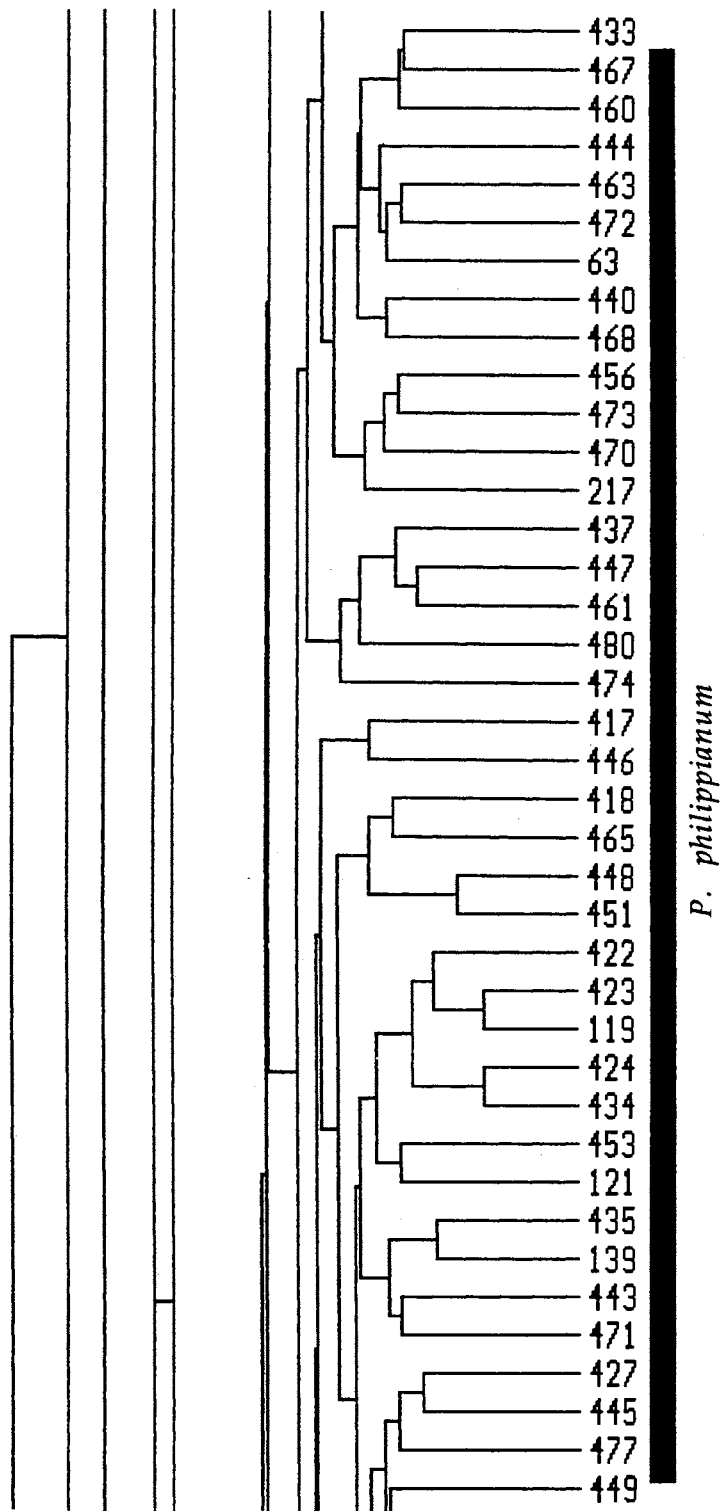


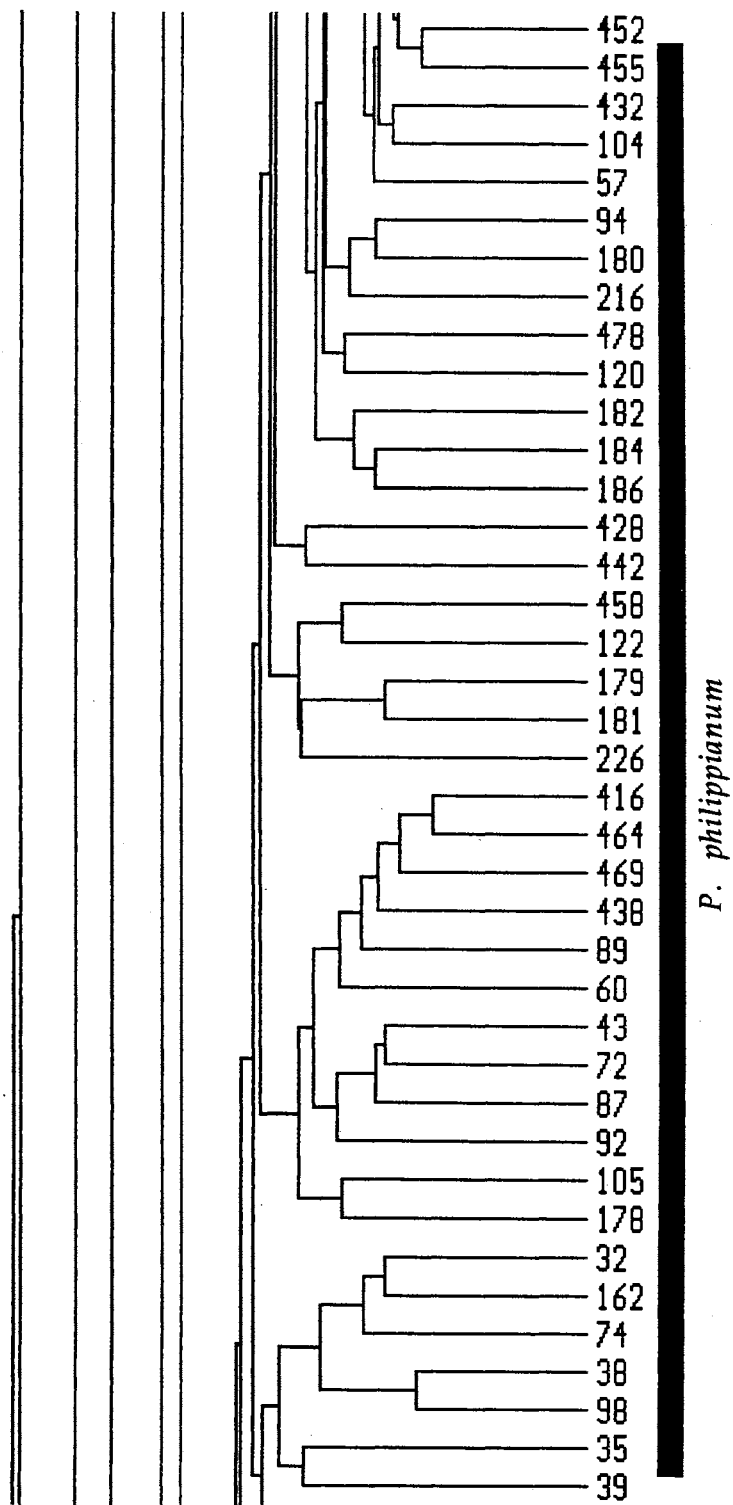


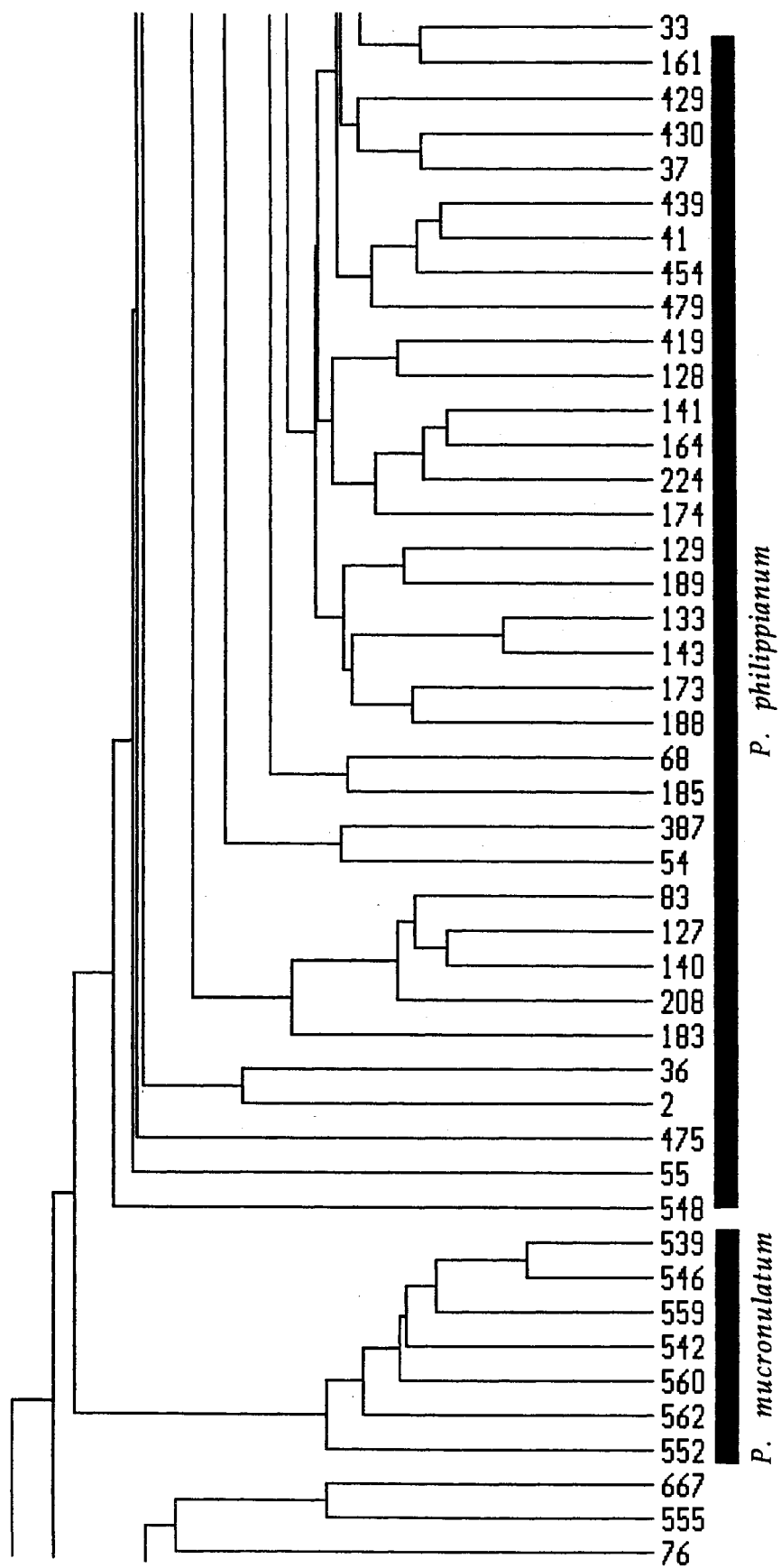




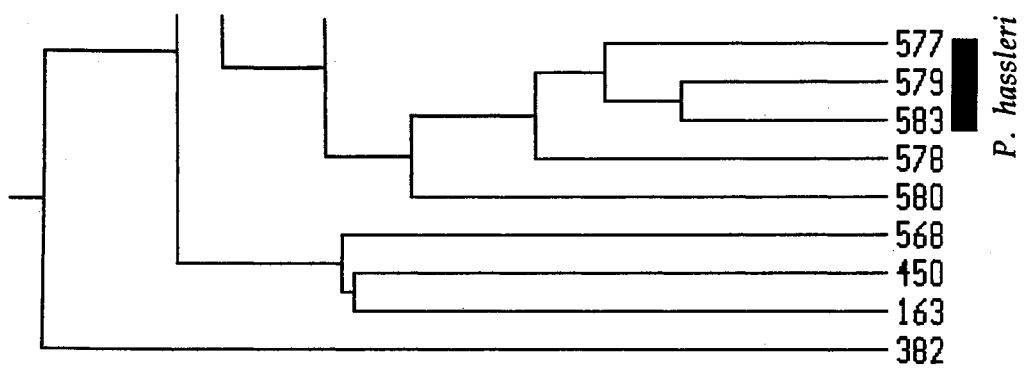












## APPENDIX H

Vascular plant collections from Boehler Seeps and Sandhills Preserve  
arranged alphabetically by species. Collections of L.C. Gatti Clark  
during the 1994 and 1995 growing seasons.

Coll. & Coll. #	Family Name	Species Name	Common Name
LGC 194	Euphorbiaceae	<i>Acalypha rhomboidea</i> Raf.	Rhombic Copperleaf
LGC 510	Euphorbiaceae	<i>Acalypha virginica</i> L.	Three Seeded Mercury
LGC 162	Poaceae	<i>Agrostis perennans</i> (Walt.) Tuckerm.	Autumn Bentgrass
LGC 310	Alismataceae	<i>Alisma subcordatum</i> Raf.	Water Plaintain
LGC 99	Liliaceae	<i>Allium canadensis</i> L.	Wild Onion
LGC 379	Asteraceae	<i>Ambrosia bidentata</i> Michx.	Lanceleaf Ragweed
LGC 361, 381	Vitaceae	<i>Ampelopsis arborea</i> (L.) Koehne	Peppervine
LGC 327	Poaceae	<i>Andropogon ternarius</i> Michx.	Splitbeard Bluestem
LGC 36, 48	Asteraceae	<i>Antennaria parlinii</i> Fern.	Plainleaf Pussytoes
LGC 437	Fabaceae	<i>Apios americana</i> Medic.	Ground Nut
LGC 429	Apocynaceae	<i>Apocynum cannabinum</i> L.	Indianhemp
LGC 198	Caryophyllaceae	<i>Arenaria serpyllifolia</i> L.	Thyme-leaved Sandwort
LGC 53	Poaceae	<i>Aria elegans</i> Willd.	Annual Siver Hairgrass
LGC 362	Poaceae	<i>Aristida desmantha</i> Trin. & Rupr.	Curly Threeawn
LGC 408	Aristolochiaceae	<i>Aristolochia reticulata</i> Nutt.	Netleaved Snakeroot
LGC 412	Asclepiadaceae	<i>Asclepias tuberosa</i> L.	Butterfly Milkweed
LGC 284, 373, 500	Asclepiadaceae	<i>Asclepias verticillata</i> L.	Whorled Milkweed
LGC 458	Asclepiadeaceae	<i>Asclepias viridis</i> Walt.	Green Milkweed
LGC 35	Fabaceae	<i>Astragalus distortus</i> Torrey & Gray	Bentpod Milkvetch
LGC 34, 125	Asteraceae	<i>Astranthium integrifolium</i> (Michx.) Nutt.	Western Daisy
LGC 245	Azollaceae	<i>Azolla caroliniana</i> Willd.	Mosquito Fern
LGC 45, 472	Fabaceae	<i>Baptisia leucophaea</i> Nutt.	White Wild Indigo
LGC 187, 266	Rhamnaceae	<i>Berchemia scandens</i> (Hill.) K. Koch	Rattan Vine
LGC 263, 325, 489	Urticaceae	<i>Boehmeria cylindrica</i> (L.) Sw.	False Nettle
LGC 419	Ophioglossaceae	<i>Botrychium virginianum</i> (L.) Sw.	Rattlesnake Fern
LGC 367	Poaceae	<i>Bouteloua hirsuta</i> Lag.	Harry Grama
LGC 244, 456	Nymphaeaceae	<i>Brasenia schreberi</i> J.F. Gmel.	Water-Shield
LGC 192	Poaceae	<i>Bromus catharticus</i> Vahl.	Rescue Grass
LGC 164, 461	Poaceae	<i>Bromus japonicus</i> Thunb. ex Murr.	Japanese Brome
LGC 94	Sapotaceae	<i>Bumelia lanuginosa</i> (Michx.) Pers.	Chittamwood

LGC 283, 375, 485	Verbenaceae	<i>Callicarpa americana</i> L.	American Beautyberry
LGC 206, 427	Callitrichaceae	<i>Callitriche heterophylla</i> Pursh	Water-Starwort
LGC 447	Bignoniaceae	<i>Campsis radicans</i> (L.) Seem.	Trumpet Creeper
LGC 82	Brassicaceae	<i>Cardamine pennsylvanica</i> Muhl. ex Willd.	Bitter Cress
LGC 421	Cyperaceae	<i>Carex bicknellii</i> Britton	Bicknell's Sedge
LGC 50	Cyperaceae	<i>Carex blanda</i> Dewey	Loose Flowered Sedge
LGC 87, 208	Cyperaceae	<i>Carex cherokeensis</i> Schwein.	Cherokee Sedge
LGC 197	Cyperaceae	<i>Carex crinita</i> Lam.	Fringed Sedge
LGC 348	Cyperaceae	<i>Carex digitalis</i> Willd.	
LGC 173, 186	Cyperaceae	<i>Carex granularis</i> Muhl. ex Willd.	Meadow Sedge
LGC 138, 200, 211	Cyperaceae	<i>Carex gravida</i> Bailey	Heavy Sedge
LGC 189	Cyperaceae	<i>Carex hyalina</i> Boott.	Whitesheath Sedge
LGC 84, 202, 203	Cyperaceae	<i>Carex lupulina</i> Muhl.	Hop Sedge
LGC 274	Cyperaceae	<i>Carex normalis</i> Mack.	Sedge
LGC 83	Cyperaceae	<i>Carex retroflexa</i> Muhl. ex Willd.	Reflexed Sedge
LGC 199	Cyperaceae	<i>Carex swanii</i> (Fern.) Mack.	Swan Sedge
LGC 146, 176	Cyperaceae	<i>Carex vulpinoidea</i> Michx.	Fox Sedge
LGC 70	Juglandaceae	<i>Carya myristiciformis</i> (Michx.) Nutt.	Nutmeg Hickory
LGC 476, 477	Juglandaceae	<i>Carya texana</i> Buckl.	Black Hickory
LGC 340, 483, 502	Caesalpiniaceae	<i>Cassia fasciculata</i> Michx.	Partridge Pea
LGC 350	Caesalpiniaceae	<i>Cassia nictitans</i> L.	Sensitive Pea
LGC 54	Scrophulariaceae	<i>Castilleja indivisa</i> Engelm.	Indian Paintbrush
LGC 416	Rhamnaceae	<i>Ceanothus americanus</i> L.	New Jersey Tea
LGC 431	Ulmaceae	<i>Celtis tenuifolia</i> Nutt.	Dwarf Hackberry
LGC 224	Poaceae	<i>Cenchrus incertus</i> M.A. Curtis	Sandbur
LGC 470	Asteraceae	<i>Centaurea americana</i> Nutt.	American Basket Flower
LGC 439, 469	Rubiaceae	<i>Cephalanthus occidentalis</i> L.	Buttonbush
LGC 247	Ceratophyllaceae	<i>Ceratophyllum demersum</i> L.	Coontail
LGC 96	Caesalpiniaceae	<i>Cercis canadensis</i> L.	Redbud
LGC 354	Poaceae	<i>Chasmanthium latifolium</i> (Michx.) Yates	Inland Seaoats
LGC 264	Poaceae	<i>Chasmanthium laxum</i> (L.) Yates ssp. <i>sessiliflorum</i> (Poir.) L. Clark	Spike Inland Seaoats
LGC 384, 387	Asteraceae	<i>Chrysopsis pilosa</i> Nutt.	Softhair Golden Aster
LGC 293	Asteraceae	<i>Chrysopsis villosa</i> (Pursh.) Nutt. ex DC	Roughhair Golden Aster
LGC 91	Asteraceae	<i>Cirsium horridulum</i> Michx.	Bull Thistle
LGC 303, 304, 330, 479	Fabaceae	<i>Clitoria mariana</i> L.	Butterfly Pea
LGC 77	Euphorbiaceae	<i>Cnidoscolus texanus</i> (Muell.-Arg.) Small	Texas Bullnettle
LGC 37, 178	Scrophulariaceae	<i>Collinsia violacea</i> Nutt.	Violet Collinsia
LGC 389	Commelinaceae	<i>Commelina erecta</i> L.	Erect Day Flower
LGC 363	Asteraceae	<i>Conyza canadensis</i> (L.) Cronq.	Horseweed
LGC 175, 459	Asteraceae	<i>Coreopsis grandiflora</i> Hogg ex Sweet	Bigflower Tickseed
LGC 159	Cornaceae	<i>Cornus florida</i> L.	Flowering Dogwood

LGC 168	Fumariaceae	<i>Corydalis micrantha</i> (Engelm.) A. Gray	Slender Fumewort
LGC 51, 93, 425	Rosaceae	<i>Crataegus spathulata</i> Michx.	Littlehip Hawthorn
LGC 339	Euphorbiaceae	<i>Croton capitatus</i> Michx.	Woolly Croton
LGC 308, 395, 487	Euphorbiaceae	<i>Croton glandulosus</i> L.	Sand Croton
LGC 307	Euphorbiaceae	<i>Crotonopsis elliptica</i> Willd.	Rush-foil
LGC 216	Cyperaceae	<i>Cyperus uniflorus</i> Boeck.	One-flower Flatsedge
LGC 219, 378	Cyperaceae	<i>Cyperus ovularis</i> (Michx.) Torr.	Globe Flatsedge
LGC 275	Cyperaceae	<i>Cyperus virens</i> Michx.	Green Flatsedge
LGC 191, 420	Poaceae	<i>Danthonia spicata</i> (L.) Beauv. ex R.&S.	Poverty Oatgrass
LGC 299, 435	Apiaceae	<i>Daucus pusillus</i> Michx.	Southwestern Carrot
LGC 430	Ranunculaceae	<i>Delphinium carolinianum</i> Walt.	Prairie Larkspur
LGC 152	Fabaceae	<i>Desmodium paniculatum</i> (L.) DC, var. <i>paniculatum</i>	Tall Tickclover
LGC 272, 337	Fabaceae	<i>Desmodium sessilifolium</i> (Torr.) Torr. & Gray	Sessile-leaf Tickclover
LGC 305	Fabaceae	<i>Desmodium viridiflorum</i> (L.) DC	Velvetleaf Tickclover
LGC 385	Rubiaceae	<i>Diodia teres</i> Walt.	Rough Buttonweed
LGC 98, 405	Droseraceae	<i>Drosera brevifolia</i> Pursh	Sundew
LGC 312	Cyperaceae	<i>Dulichium arundinaceum</i> (L.) Britt.	Threeway Sedge
LGC 463	Asteraceae	<i>Echinacea pallida</i> Nutt.	Pale Coneflower
LGC 300, 488	Alismataceae	<i>Echinodorus tenellus</i> (Mart.) Beuchenu	Lanceleaf Burweed
LGC 171	Cyperaceae	<i>Eleocharia compressa</i> Sulliv.	Flatstem Spikesedge
LGC 150	Cyperaceae	<i>Eleocharis acicularis</i> (L.) Roem. & Schult., var. <i>gracilescens</i> Svens.	Needle Spikesedge
LGC 236	Cyperaceae	<i>Eleocharis engelmannii</i> Steud.	Engelman's Spikesedge
LGC 237	Cyperaceae	<i>Eleocharis obtusa</i> (Willd.) Schultes, var. <i>lanceolata</i> (Fern.) Gilly	Blunt Spikesedge
LGC 239	Cyperaceae	<i>Eleocharis parvula</i> (R.&S.) Link, var. <i>anachaeta</i> (Torr.) Svens.	Dwarf Spikesedge
LGC 92	Cyperaceae	<i>Eleocharis tenuis</i> (Willd.) Schult., var. <i>verrucosa</i> (Svens.) Svens.	Slender Spikesedge
LGC 376	Asteraceae	<i>Elephantopus carolinianus</i> Raeusch.	Elephant's Foot
LGC 267, 380	Poaceae	<i>Elymus virginicus</i> L.	Virginia Wildrye
LGC 377	Poaceae	<i>Eragrostis secundiflora</i> Presl.	Red Lovegrass
LGC 326	Poaceae	<i>Eragrostis spectabilis</i> (Pursh) Steud.	Purple Lovegrass
LGC 57, 163, 295, 333	Asteraceae	<i>Erigeron strigosus</i> Muhl ex. Willd.	Daisy Fleabane
LGC 481	Eriocaulaceae	<i>Eriocaulon kornickianum</i> Van Heurch & Muell.-Arg.	Small Pipewort
LGC 134, 218, 434	Polygonaceae	<i>Eriogonum longifolium</i> Nutt.	Longleaf Eriogonum
LGC 290, 495	Apiaceae	<i>Eryngium prostratum</i> Nutt. ex DC	Creeping Eryngo
LGC 493	Euphorbiaceae	<i>Euphorbia serpens</i> H.B.K.	Round-leaved Spurge
LGC 59	Asteraceae	<i>Evax multicaulis</i> DC	Rabbits Tobacco
LGC 149	Asteraceae	<i>Evax prolifera</i> Nutt. ex DC	Rabbit Tobacco
LGC 371	Amaranthaceae	<i>Froelichia floridana</i> (Nutt.) Moq.	Snake Cotton
LGC 280, 364	Asteraceae	<i>Gaillardia aestivalis</i> (Walt.) Rock	Prairie Gaillardia

LGC 370, 390	Fabaceae	<i>Galactia regularis</i> (L.) B.S.P.	Downey Milkpea
LGC 205	Rubiaceae	<i>Galium arkansanum</i> A. Gray	Arkansas Bedstraw
LGC 444	Rubiaceae	<i>Galium circaezans</i> Michx.	Woods Bedstraw
LGC 95	Rubiaceae	<i>Galium obtusum</i> Bigelow	Bluntleaf Bedstraw
LGC 183, 306	Rubiaceae	<i>Galium pilosum</i> Ait.	Hairy Bedstraw
LGC 160	Geraniaceae	<i>Geranium carolinianum</i> L.	Carolina Cranesbill
LGC 80	Caesalpiniaceae	<i>Gleditsia triacanthos</i> L.	Honey Locust
LGC 383	Asteraceae	<i>Gnaphalium obtusifolium</i> L.	Sweet Everlasting
LGC 170	Asteraceae	<i>Gnaphalium purpureum</i> L.	Purple Cudweed
LGC 151	Scrophulariaceae	<i>Gratiola virginiana</i> L.	Virginia Hedgehyssop
LGC 365	Poaceae	<i>Gymnopogon ambiguus</i> (Michx.) B.S.P.	Broadleaf Skeletongrass
LGC 346	Asteraceae	<i>Haplopappus divaricatus</i> (Nutt.) Gray	Scratch Daisy
LGC 44	Rubiaceae	<i>Hedyotis australis</i> Lewis & Moore	Bluet
LGC 382	Asteraceae	<i>Helianthus hirsutus</i> Raf.	Hairy Sunflower
LGC 287, 466	Asteraceae	<i>Hieracium gronovii</i> L.	Hawkweed
LGC 336, 355	Asteraceae	<i>Hieracium longipilum</i> Torr.	Longbeard Hawkweed
LGC 89	Primulaceae	<i>Hottonia inflata</i> Ell.	American Featherfoil
LGC 432	Asteraceae	<i>Hymenopappus scabiosaeus</i> L'Her.	Old Plainsman
LGC 350	Clusiaceae	<i>Hypericum drummondii</i> (Grev. & Hook.) Torr. & Gray	Nits-and-Lice
LGC 221, 273	Clusiaceae	<i>Hypericum hypericoides</i> (L.) Crantz	St. Andrew's Cross
LGC 292	Clusiaceae	<i>Hypericum spathulatum</i> (Spach.) Steud.	St. John's-wort
LGC 40	Liliaceae	<i>Hypoxis hirsuta</i> (L.) Coville	Yellow Stargrass
LGC 154	Aquifoliaceae	<i>Ilex decidua</i> Walt.	Deciduous Holly
LGC 251, 445	Balsaminaceae	<i>Impatiens capensis</i> Meerb.	Spotted Touch-me-not
LGC 501	Convolvulaceae	<i>Ipomoea pandurata</i> (L.) Mey.	Wild Potatovine
LGC 130	Iridaceae	<i>Iris virginica</i> L.	Southern Blue Flag
LGC 240	Juncaceae	<i>Juncus acuminatus</i> Michx.	Jointed Rush
LGC 234, 344, 407	Juncaceae	<i>Juncus coriaceous</i> Mack.	Leathery Rush
LGC 90, 195	Juncaceae	<i>Juncus effusus</i> L.	Bog Rush
LGC 172	Juncaceae	<i>Juncus marginatus</i> Rostk.	Grassleaf Rush
LGC 204, 506	Juncaceae	<i>Juncus scirpoides</i> Lam.	Needlepod Rush
LGC 238	Juncaceae	<i>Juncus tenuis</i> Willd.	Tender Rush
LGC 126	Asteraceae	<i>Krigia cespitosa</i> (Raf.) K.L. Chambers	Common Dwarf Dandelion
LGC 55	Asteraceae	<i>Krigia dandelion</i> (L.) Nutt.	Potato Dandelion
LGC 127	Asteraceae	<i>Krigia virginica</i> (L.) Willd.	Dwarf Dandelion
LGC 332	Asteraceae	<i>Lactuca canadensis</i> L.	Wild Lettuce
LGC 323	Asteraceae	<i>Lactuca canadensis</i> L., var. <i>latifolia</i> Kuntze	Wild Lettuce
LGC 227, 329, 486	Cistaceae	<i>Lechea villosa</i> Ell.	Pinweed
LGC 235	Poaceae	<i>Leersia oryzoides</i> (L.) Sw.	Swartz Cutgrass
LGC 63, 121	Brassicaceae	<i>Lepidium virginicum</i> L.	Poorman's Peppergrass
LGC 220, 331	Fabaceae	<i>Lespedeza stuevei</i> Nutt.	Tall Lespedeza
LGC 335	Asteraceae	<i>Liatris aspera</i> Michx.	Tall Gayfeather

LGC 396	Asteraceae	<i>Liatris squarrosa</i> (L.) Michx.	Gayfeather
LGC 38, 174, 433	Scrophulariaceae	<i>Linaria canadensis</i> (L.) Dumont	Blue Toadflax
LGC 301	Scrophulariaceae	<i>Lindernia dubia</i> (L.) Pennell	Yellowseed False Pimpernell
LGC 124, 185, 414	Boraginaceae	<i>Lithospermum caroliniense</i> (Walt. ex Gmel.) MacM.	Plains Puccoon
LGC 144	Caprifoliaceae	<i>Lonicera japonica</i> Thunb.	Japanese Honeysuckle
LGC 324, 504	Onagraceae	<i>Ludwigia alternifolia</i> L.	Bushy Seedbox
LGC 85	Juncaceae	<i>Luzula bulbosa</i> (Wood) Rydb.	Bulb Woodrush
LGC 122, 188, 413	Asclepiadaceae	<i>Matelea biflora</i> (Raf.) Woodson	Twoflower Milkvine
LGC 505	Lamiaceae	<i>Monarda punctata</i> L.	Horsemint
LGC 156, 415	Lamiaceae	<i>Monarda russeliana</i> Nutt. ex Sims.	Red Spotted Horsemint
LGC 417	Monotropaceae	<i>Monotropa hypopithys</i> L.	Pinesap
LGC 123	Borganiaceae	<i>Myosotis verna</i> Nutt.	Early Scorpiongrass
LGC 131	Nymphaeaceae	<i>Nuphar lutea</i> (L.) J.E. Smith	Yellow Pond Lily
LGC 261, 309	Nymphaeaceae	<i>Nymphaea odorata</i> Ait.	American Water Lily
LGC 248	Menyanthaceae	<i>Nymphoides peltata</i> (Gmelin) Kuntze	Yellow Floating Heart
LGC 56, 118, 252- 257	Nyssaceae	<i>Nyssa sylvatica</i> Marsh.	Black Gum
LGC 157	Onagraceae	<i>Oenothera laciniata</i> Hill	Cutleaf Evening Primrose
LGC 133	Dryopteridaceae	<i>Onoclea sensibilis</i> L.	Sensitive Fern
LGC 136	Osmundaceae	<i>Osmunda cinnamomea</i> L.	Cinnamon Fern
LGC 142, 148, 270, 455	Osmundaceae	<i>Osmunda regalis</i> L., var. <i>spectabilis</i> (Willd.) A. Gray	Royal Fern
LGC 102	Oxalidaceae	<i>Oxalis violacea</i> L., var. <i>violacea</i>	Violet Wood Sorrel
LGC 180, 492	Oxalidaceae	<i>Oxalis stricta</i> L.	Yellow Wood Sorrel
LGC 233	Poaceae	<i>Panicum anceps</i> Michx.	Beaked Panicum
LGC 228	Poaceae	<i>Panicum boscii</i> Poir.	Bosc Panicum
LGC 223	Poaceae	<i>Panicum depauperatum</i> Michx.	Slimleaf Panicum
LGC 509	Poaceae	<i>Panicum dichotomiflorum</i> Michx.	Fall Panicum
LGC 508	Poaceae	<i>Panicum dichotomum</i> L.	Forked Panicum
LGC 241, 243	Poaceae	<i>Panicum hians</i> Ell.	Gaping Panicum
LGC 213	Poaceae	<i>Panicum lanuginosum</i> Ell.	Woolly Panicum
LGC 64, 214, 338, 358	Poaceae	<i>Panicum linearifolium</i> Scribn.	Slimleaf Panicum
LGC 46, 196	Poaceae	<i>Panicum oligosanthos</i> Schult.	Small Panicgrass
LGC 392	Poaceae	<i>Panicum ravenelii</i> Scribn.	Panicum
LGC 181, 372	Poaceae	<i>Panicum sphaerocarpon</i> Ell.	Leafy Panicum
LGC 60, 291, 347	Caryophyllaceae	<i>Paronychia drummondii</i> Torrey & Gray	Drummond's Nailwort
LGC 249	Vitaceae	<i>Parthenocissus quinquefolia</i> (L.) Planch.	Virginia Creeper
LGC 217, 355, 366	Poaceae	<i>Paspalum setaceum</i> Michx.	Thin Paspalum
LGC 86	Scrophulariaceae	<i>Pedicularis canadensis</i> L., var. <i>dobsii</i> Fern.	Common Lousewort
LGC 97, 226, 449	Scrophulariaceae	<i>Penstemon laxiflorus</i> Pennell	Loose Flower Penstemon

LGC 282, 491	Fabaceae	<i>Petalostemon phleoides</i> Nutt.	Longbract Prairie Clover
LGC 67, 184	Hydrophyllaceae	<i>Phacelia strictiflora</i> (Engelm. & Gray) Gray, var. <i>robbinsii</i> Constance	Prairie Blue Curls
LGC 467	Polemoniaceae	<i>Phlox glaberrima</i> L.	Smooth Phlox
LGC 75	Polemoniaceae	<i>Phlox pilosa</i> L.	Prairie Phlox
LGC 478	Verbenaceae	<i>Phryma leptostachya</i> L.	Lopseed
LGC 260	Solanaceae	<i>Physalis heterophylla</i> Nees.	Clammy Ground Cherry
LGC 81	Pinaceae	<i>Pinus echinata</i> Mill.	Shortleaf Pine
LGC 61	Plantaginaceae	<i>Plantago lanceolata</i> L.	Buckhorn Plantain
LGC 215	Plantaginaceae	<i>Plantago patagonica</i> Jacq.	Wooly Plantain
LGC 42	Plantaginaceae	<i>Plantago purshii</i> R & S, var. <i>purshii</i>	Wooly Plantain
LGC 158	Plantaginaceae	<i>Plantago virginica</i> L.	Paleseed Plantain
LGC 193	Plantaginaceae	<i>Plantago wrightiana</i> Dcme.	Wright's Plantain
LGC 442	Berberidaceae	<i>Podophyllum peltatum</i> L.	May Apple
LGC 404, 473	Polygonaceae	<i>Polygonella americana</i> (Fisch. & Mey.) Small	Southern Jointweed
LGC 297	Polygonaceae	<i>Polygonum hydropiperoides</i> Michx.	Mild Water Pepper
LGC 352	Polygonaceae	<i>Polygonum persicaria</i> L.	Lady's Thumb
LGC 231, 289	Loganiaceae	<i>Polypremum procumbens</i> L.	Juniperleaf
LGC 128	Potamogetonaceae	<i>Potamogeton pulcher</i> Tuckerm.	Spotted Pondweed
LGC 207	Rosaceae	<i>Potentilla simplex</i> Michx.	Old-field Cinquefoil
LGC 143, 440	Lamiaceae	<i>Prunella vulgaris</i> L.	Heal-all
LGC 446	Rosaceae	<i>Prunus serotina</i> Ehrh.	Black Cherry
LGC 232	Fabaceae	<i>Psoralea diditata</i> Nutt.	Palm-leaved Scurf Pea
LGC 465	Fabaceae	<i>Psoralea psoraloides</i> (Walt.) Cory	Sampson's Snakeroot
LGC 475, 480	Apiaceae	<i>Ptilimnium capillaceum</i> (Michx.) Raf.	Threadleaf
LGC 328	Lamiaceae	<i>Pycnanthemum albescens</i> Torr. & Gray	Mockbishopweed
LGC 391	Asteraceae	<i>Pyrrhopappus carolinianus</i> (Walt.) DC	Whiteleaf Mountainmint
LGC 484	Fagaceae	<i>Quercus falcata</i> Michx.	False Dandelion
LGC 69	Fagaceae	<i>Quercus falcata</i> Michx., var. <i>triloba</i> (Michx.) Nutt.	Southern Red Oak
LGC 120, 212	Fagaceae	<i>Quercus nigra</i> L.	Southern Red Oak
LGC 74	Fagaceae	<i>Quercus stellata</i> Wang.	Water Oak
LGC 71	Fagaceae	<i>Quercus velutina</i> Lam.	Post Oak
LGC 116, 179, 428	Ranunculaceae	<i>Ranculus laxicaulis</i> (Torr. & Gray) Darby	Black Oak
LGC 119, 182, 482	Rhamnaceae	<i>Rhamnus caroliniana</i> Walt.	Spearwort
LGC 271, 296, 499	Melastomaceae	<i>Rhexia mariana</i> L.	Buckthorn
LGC 58	Anacardiaceae	<i>Rhus aromatica</i> Ait.	Meadow Beauty
LGC 259	Anacardiaceae	<i>Rhus copallina</i> L.	Lemon Sumac
LGC 281, 349, 393, 474	Fabaceae	<i>Rhynchosia latifolia</i> Nutt. ex Torrey & Gray	Winged Sumac
LGC 276	Cyperaceae	<i>Rhynchospora caduca</i> Ell.	Broadleaf Snoutbean
LGC 406	Cyperaceae	<i>Rhynchospora capitellata</i> (Michx.) Vahl.	Anglestem Beakrush
LGC 471, 494	Cyperaceae	<i>Rhynchospora glomerata</i> (L.) Vahl	False Bog Rush
LGC 302	Lythraceae	<i>Rotala ramosior</i> (L.) Koehne	Clustered Beakrush
			Toothcup

LGC 452	Rosaceae	<i>Rubus occidentalis</i> L.	Blackberry
LGC 169	Rosaceae	<i>Rubus ostryifolius</i> Rydb.	Highbush Blackberry
LGC 277, 386	Asteraceae	<i>Rudbeckia hirta</i> L.	Blackeyed Susan
LGC 334	Acanthaceae	<i>Ruellia humilis</i> Nutt.	Fringed Leaf Ruellia
LGC 73, 161, 423, 424	Polygonaceae	<i>Rumex hastatulus</i> Baldw.	Heartwing Sorrel
LGC 225	Poaceae	<i>Sacciolepis striata</i> (L.) Nash	American Cupscale
LGC 454	Alismataceae	<i>Sagittaria latifolia</i> Willd.	Wapato, Duck Potato
LGC 141	Lamiaceae	<i>Salvia lyrata</i> L.	Lyreleaf Sage
LGC 242, 279, 441	Apiaceae	<i>Sanicula canadensis</i> L.	Black Snakeroot
LGC 153	Apiaceae	<i>Sanicula gregaria</i> Bickn.	Cluster Snakeroot
LGC 33	Lauraceae	<i>Sassafras albidum</i> (Nutt.) Nees, var. <i>molle</i> (Raf.) Fern.	Sassafras
LGC 209, 343	Mimosaceae	<i>Schrankia nuttallii</i> (DC ex Britt. & Rose) Standl.	Sensitive Briar
LGC 359	Mimosaceae	<i>Schrankia ucinata</i> Willd.	Catclaw Briar
LGC 426	Cyperaceae	<i>Scirpus koilolepis</i> (Steud.) Gleason	Bulrush
LGC 357	Cyperaceae	<i>Scleria ciliata</i> Michx.	Fringed Nutrush
LGC 139, 464	Cyperaceae	<i>Scleria triglomerata</i> Michx.	Whip Nutrush
LGC 286, 369	Lamiaceae	<i>Scutellaria elliptica</i> Muhl.	Hairy Skullcap
LGC 41	Lamiaceae	<i>Scutellaria parvula</i> Michx., var. <i>leonardii</i> (Epl.) Fern	Skullcap
LGC 222, 368	Selaginellaceae	<i>Selaginella rupestris</i> (L.) Spring.	Rock Spikemoss
LGC 32	Asteraceae	<i>Senecio obovatus</i> Muhl., var. <i>rotundus</i> Britton	Roundleaf Goundsel
LGC 278	Poaceae	<i>Setaria geniculata</i> (Lam.) Beauv.	Knotroot Bristlegrass
LGC 145	Iridaceae	<i>Sisyrinchium angustifolium</i> Miller	Blue-eyed Grass
LGC 155, 438, 443, 448	Smilicaceae	<i>Smilax bona-nox</i> L.	Greenbriar
LGC 49	Smilacaceae	<i>Smilax rotundifolia</i> L.	Common Greenbriar
LGC 460	Solanaceae	<i>Solanum carolinense</i> L.	Carolina Horsenettle
LGC 341	Asteraceae	<i>Solidago canadensis</i> L.	Common Prairie Goldenrod
LGC 374	Asteraceae	<i>Solidago missouriensis</i> Nutt.	Missouri Goldenrod
LGC 356	Asteraceae	<i>Solidago ulmifolia</i> Muhl. ex Willd.	Elmleaf Goldenrod
LGC 360	Poaceae	<i>Sorghum halpense</i> (L.) Pers.	Johnsongrass
LGC 410	Apiaceae	<i>Spermolepis divaricata</i> (Walt.) Britt.	Forked Scaleseed
LGC 411	Apiaceae	<i>Spermolepis echinata</i> (Nutt.) Heller	Bristly Scaleseed
LGC 76, 140, 177, 190	Apiaceae	<i>Spermolepis inermis</i> (Nutt.) Math. & Const.	Spreading Scaleseed
LGC 147, 436	Poaceae	<i>Sphenopholis obtusata</i> (Michx.) Scribn.	Prairie Wedgescale
LGC 246	Lemnaceae	<i>Spirodela polyrhiza</i> (L.) Schleiden	Duck Meat
LGC 311	Caryophyllaceae	<i>Stellaria media</i> L.	Chickweed
LGC 167, 450	Euphorbiaceae	<i>Stillingia sylvatica</i> L.	Queen's Delight
LGC 468	Fabaceae	<i>Strophostyles helvola</i> (L.) Ell.	Wild Bean
LGC 285, 496	Convolvulaceae	<i>Stylisma pickeringii</i> (Torr.) A. Gray	
LGC 288, 345	Fabaceae	<i>Stylosanthes biflora</i> (L.) B.S.P.	Pencil-flower



LGC 342	Caprifoliaceae	<i>Symphoricarpos orbiculatus</i> Moench.	Buckbrush
LGC 298, 409, 507	Fabaceae	<i>Tephrosia virginiana</i> (L.) Pers.	Goat's Rue
LGC 422	Apiaceae	<i>Torilis arvensis</i> (Huds.) Link	Hedge Parsley
LGC 101	Anacardiaceae	<i>Toxicodendron radicans</i> (L.) O.Ktze	Poision Ivy
LGC 135, 462	Commelinaceae	<i>Tradescantia ohiensis</i> Raf.	Ohio Spiderwort
LGC 388	Poaceae	<i>Tridens flavus</i> (L.) Hitchc.	Purpletop
LGC 43	Fabaceae	<i>Trifolium campestre</i> Schreb.	Low Hop Clover
LGC 137, 165	Campanulaceae	<i>Triodanis perfoliata</i> (L.) Nieuw.	Clasping Venus Looking- glass
LGC 262	Typhaceae	<i>Typha angustifolia</i> L.	Narrow-leaved Cattail
LGC 129, 249, 457, 503	Lentibulariaceae	<i>Utricularia biflora</i> Lam.	Twoflower Bladderwort
LGC 210, 258	Ericaceae	<i>Vaccinium arboreum</i> Marsh.	Farkleberry
LGC 52	Valerianaceae	<i>Valerianella radiata</i> (L.) Dufr., forma radiata	Common Beaked Corns salad
LGC 418	Asteraceae	<i>Verbesina helianthoides</i> Michx.	Yellow Crownbeard
LGC 117, 132	Caprifoliaceae	<i>Viburnum rufidulum</i> Raf.	Rusty Blackhaw
LGC 100	Fabaceae	<i>Vicia sativa</i> L.	Common Vetch
LGC 39	Violaceae	<i>Viola villosa</i> Walt.	Wooly Violet
LGC 201, 265, 490	Vitaceae	<i>Vitis aestivalis</i> Michx.	Pigeon Grape
LGC 88, 166, 394, 451	Vitaceae	<i>Vitis rotundifolia</i> Michx.	Muscadine
LGC 62	Poaceae	<i>Vulpia octoflora</i> (Walt.) Rydb.	Sixweeks Fescue
LGC 294, 453	Dryopteridaceae	<i>Woodsia obtusa</i> (Spreng.) Torr.	Blunt-lobed Cliff Fern
LGC 268, 269	Poaceae	<i>Zizaniopsis miliacea</i> (Michx.) Doell. & Asch.	Southern Wildrice

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## APPENDIX I

Vascular plant collections from Boehler Seeps and Sandhills Preserve  
arranged alphabetically by species. Collections made by  
The Nature Conservancy personnel.

Coll. & Coll. #	Collection Date	Family Name	Species Name
McCarty s.n.*	4/25/92	Asteraceae	<i>Achillea millefolium</i> L.
McCarty s.n.	9/13/92	Scrophulariaceae	<i>Agalinis tenuifolia</i> (Vahl.) Raf.
Hamilton #22	5/17/89	Liliaceae	<i>Allium canadense</i> L.
McCarty s.n.	8/23/92 & 9/13/92	Asteraceae	<i>Ambrosia artemesifolia</i> L.
McCarty s.n.	9/13/92	Asteraceae	<i>Ambrosia bidentata</i> Michx.
McCarty s.n.	9/13/92	Asteraceae	<i>Ambrosia trifida</i> L.
McCarty s.n.	9/12/92	Poaceae	<i>Andropogon gerardii</i> Vitman, var. <i>gerardii</i>
McCarty s.n.	5/27/92 & 7/5/92	Asteraceae	<i>Antennaria parlinii</i> Fern.
McCarty s.n.	7/5/92	Aristolochiaceae	<i>Aristolochia reticulata</i> Nutt.
McCarty s.n.	9/12/92	Asteraceae	<i>Aster patens</i> Ait.
McCarty s.n.	9/13/92	Asteraceae	<i>Aster subulatus</i> Micx.
Hamilton #28	6/10/89	Fabaceae	<i>Baptisia bracteata</i> Ell.
McCarty s.n.	9/13/92	Asteraceae	<i>Bidens aristosa</i> (Michx.) Britt.
McCarty s.n.	6/26/92	Urticaceae	<i>Boehmeria cylindrica</i> (L.) Sw.
McCarty s.n.	5/27/92	Poaceae	<i>Bromus hordeaceus</i> L.
McCarty s.n.	4/25/92	Cyperaceae	<i>Carex bicknellii</i> Britt.
McCarty s.n.	4/25/92 & 5/27/92	Cyperaceae	<i>Carex complanata</i> Torr. & Hook.
McCarty s.n.	4/25/92 & 5/27/92	Cyperaceae	<i>Carex digitalis</i> Willd.
McCarty s.n.	5/27/92	Cyperaceae	<i>Carex frankii</i> Kunth.
McCarty s.n.	5/8/92	Cyperaceae	<i>Carex muhlenbergii</i> Schkuhr ex Willd.
Blackmon #33	5/24/90	Cyperaceae	<i>Carex squarrosa</i> L.
Hamilton #23	5/17/89	Scrophulariaceae	<i>Castilleja coccinea</i> (L.) Spreng.
McCarty s.n.	7/30/92	Poaceae	<i>Cenchrus incertus</i> M.A. Curtis
McCarty s.n.	4/25/92	Apiaceae	<i>Chaerophyllum tainturieri</i> Hook.
McCarty s.n.	4/27/92	Asteraceae	<i>Chaetopappa asteroides</i> Nutt. ex DC
McCarty s.n.	7/5/92	Poaceae	<i>Chasmanthium latifolium</i> (Michx.) Yates
McCarty s.n.	7/30/92	Poaceae	<i>Chasmanthium laxum</i> (L.) Yates
McCarty s.n.	9/12/92	Asteraceae	<i>Chrysopsis pilosa</i> Nutt.
McCarty s.n.	9/13/92	Asteraceae	<i>Cirsium altissimum</i> (L.) Spreng.
McCarty s.n.	9/12/92	Asteraceae	<i>Conyza canadensis</i> (L.) Cronq.

McCarty s.n.	5/27/92	Asteraceae	<i>Coreopsis grandiflora</i> Hogg ex Sweet
McCarty s.n.	7/5/92	Cyperaceae	<i>Cyperus ovularis</i> (Michx.) Torr.
McCarty s.n.	7/30/92	Cyperaceae	<i>Cyperus strigosus</i> L.
McCarty	5/27/92	Apiaceae	<i>Daucus pusillus</i> Michx.
McCarty s.n.	5/27/92	Droseraceae	<i>Drosera brevifolia</i> Pursh
Hamilton #29	6/10/89	Asteraceae	<i>Echinacea pallida</i> Nutt.
McCarty s.n.	7/5/92	Asteraceae	<i>Echinacea pallida</i> Nutt.
McCarty s.n.	5/27/92	Cyperaceae	<i>Eleocharis compressa</i> Sulliv.
McCarty s.n.	7/5/92	Cyperaceae	<i>Eleocharis obtusa</i> (Willd.) Schultes
McCarty s.n.	9/12/92	Asteraceae	<i>Elephantopus carolinianus</i> Raeuschel.
McCarty s.n.	6/13/92	Poaceae	<i>Elymus virginicus</i> L.
McCarty s.n.	8/23/92	Poaceae	<i>Eragrostis capillaris</i> (L.) Nees
McCarty s.n.	9/12/92	Poaceae	<i>Eragrostis hirsuta</i> (Michx.) Nees
McCarty s.n.	9/13/92	Asteraceae	<i>Erechtites hieracifolia</i> (L.) Raf. ex DC
McCarty s.n.	9/13/92	Poaceae	<i>Erianthus giganteus</i> (Walt.) Muhl.
McCarty s.n.	5/8/92	Asteraceae	<i>Erigeron strigosus</i> Muhl. ex Willd.
Blackmon #1	6/19/90	Eriocaulaceae	<i>Eriocaulon kornickianum</i> Van Heurch & Muell.-Arg.
McCarty s.n.	5/27/92	Polygonaceae	<i>Eriogonum longifolium</i> Nutt.
McCarty s.n.	9/12/92	Polygonaceae	<i>Eriogonum multiflorum</i> Benth.
McCarty s.n.	9/13/92	Asteraceae	<i>Eupatorium coelestinum</i> L.
McCarty s.n.	9/13/92	Asteraceae	<i>Eupatorium perfoliatum</i> L.
McCarty s.n.	4/25/92	Rubiaceae	<i>Galium arkansanum</i> A. Gray
Hamilton #34	5/17/90	Rubiaceae	<i>Galium obtusum</i> Bigelow
McCarty s.n.	4/25/92	Asteraceae	<i>Gnaphalium purpureum</i> L.
McCarty s.n.	9/12/92	Asteraceae	<i>Happlopappus divaricatus</i> (Nutt.) Gray
McCarty s.n.	8/23/92	Asteraceae	<i>Helenium amarum</i> (Raf.) H. Rock
McCarty s.n.	9/13/92	Asteraceae	<i>Helianthus angustifolius</i> L.
McCarty s.n.	9/13/92	Asteraceae	<i>Helianthus hirsutus</i> Raf.
Blackmon #32	5/24/90	Cyperaceae	<i>Hemicarpha aristulata</i> (Cov.) Smyth
McCarty s.n.	5/27/92	Asteraceae	<i>Hieracium gronovii</i> L.
Hamilton #15	5/17/89	Primulaceae	<i>Hottonia inflata</i> Ell.
McCarty s.n.	7/30/92	Apiaceae	<i>Hydrocotyle verticillata</i> Thunb.
McCarty s.n.	8/24/92	Hydrophyllaceae	<i>Hydrolea ovata</i> Nutt.
McCarty s.n.	7/30/92	Clusiaceae	<i>Hypericum drummondii</i> (Grev. & Hook.) Torr. & Gray
McCarty s.n.	8/23/92	Clusiaceae	<i>Hypericum hypericoides</i> (L.) Crantz
McCarty s.n.	7/5/92	Clusiaceae	<i>Hypericum spathulatum</i> (Spach) Steudel
Hamilton #16	5/17/89	Liliaceae	<i>Hypoxis hirsuta</i> (L.) Cov.
McCarty s.n.	6/13/92	Convolvulaceae	<i>Ipomoea pandurata</i> (L.) Mey.
Hamilton #9	5/17/89	Juncaceae	<i>Juncus coriaceus</i> Mack.
Blackmon #31	5/24/90	Juncaceae	<i>Juncus marginatus</i> Rostk.
McCarty s.n.	7/5/92	Juncaceae	<i>Juncus scirpoides</i> Lam.
McCarty s.n.	4/25/92	Asteraceae	<i>Krigia cespitosa</i> (Raf.) K.L. Chambers
McCarty s.n.	4/25/92	Asteraceae	<i>Krigia dandelion</i> (L.) Nutt.
McCarty s.n.	7/5/92	Asteraceae	<i>Lactuca sativa</i> L.
McCarty s.n.	4/25/92	Brassicaceae	<i>Lepidium virginicum</i> L.
McCarty s.n.	9/13/92	Asteraceae	<i>Liatris elegans</i> (Walt.) Michx.
McCarty s.n.	5/27/92	Boraginaceae	<i>Lithospermum caroliniense</i> (Walt. ex Gmel.) MacM
McCarty s.n.	9/13/92	Lamiaceae	<i>Lycopus virginicus</i> L.
McCarty s.n.	6/13/92	Primulaceae	<i>Lysimachia lanceolata</i> Walt.
McCarty s.n.	9/13/92	Asteraceae	<i>Mikania scandens</i> (L.) Willd.

McCarty s.n.	6/12/90 & 7/5/92	Lamiaceae	<i>Monarda punctata</i> L.
McCarty s.n.	5/27/93	Monotropaceae	<i>Monotropa hypopithys</i> L.
Blackmon #8	5/24/90	Osmundaceae	<i>Osmunda regalis</i> L.
McCarty s.n.	8/23/92	Poaceae	<i>Panicum anceps</i> Michx.
Hamilton #18	6/10/89	Poaceae	<i>Panicum hians</i> Ell.
McCarty s.n.	4/28/92 & 5/26/92	Poaceae	<i>Panicum lanuginosum</i> Ell.
Hamilton #19	6/10/89	Poaceae	<i>Panicum oligosanthos</i> Schultes
McCarty s.n.	9/15/92	Poaceae	<i>Paspalum laeve</i> Michx.
McCarty s.n.	7/30/92	Poaceae	<i>Paspalum setaceum</i> Michx.
Hamilton #11	6/10/89	Scrophulariaceae	<i>Penstemon laxiflorus</i> Pennell
McCarty s.n.	4/25/92	Scrophulariaceae	<i>Penstemon murrayanus</i> Hooker
McCarty s.n.	4/25/92	Hydrophyllaceae	<i>Phacelia strictifolia</i> (Englem. & Gray) Gray
Blackmon #36	5/24/90	Pinaceae	<i>Pinus echinata</i> Mill.
McCarty s.n.	5/27/92	Orchidaceae	<i>Platanthera flava</i> (L.) Linl.
McCarty s.n.	9/13/92	Asteraceae	<i>Pluchea camphorata</i> (L.) DC
McCarty s.n.	7/30/92	Polygalaceae	<i>Polygala sanguinea</i> L.
Blackmon #6	5/24/90	Polygonaceae	<i>Polygonella americana</i> (Fisch. & Mey.) Small
McCarty s.n.	8/23/92	Polygonaceae	<i>Polygonum hydropiperoides</i> Michx.
McCarty s.n.	6/13/92	Polygonaceae	<i>Polygonum sagittatum</i> L.
Hamilton #27	5/17/89	Lamiaceae	<i>Prunella vulgaris</i> L.
McCarty s.n.	5/27/92	Lamiaceae	<i>Prunella vulgaris</i> L.
McCarty s.n.	5/26/92	Fabaceae	<i>Psoralea subulata</i> Bush.
Coll Unkn #1	not given	Fabaceae	<i>Psoralea psoraloides</i> (Walt.) Cory
Blackmon #3	5/24/90	Fabaceae	<i>Psoralea simplex</i> Nutt. ex Torr. & Gray
McCarty s.n.	6/13/92	Apiaceae	<i>Ptilimnium capillaceum</i> (Michx.) Raf.
McCarty s.n.	8/23/92	Lamiaceae	<i>Pycnanthemum albescens</i> Torr. & Gray
Blackmon #5	5/24/90	Lamiaceae	<i>Pycnanthemum tenuifolium</i> Schrad.
McCarty s.n.	7/5/92	Asteraceae	<i>Pyrrhopappus carolinianus</i> (Walt.) DC
Blackmon #14	7/12/90	Fagaceae	<i>Quercus incana</i> Bartr.
Hamilton #12	5/17/89	Fagaceae	<i>Quercus nigra</i> L.
Hamilton #13	5/17/89	Fagaceae	<i>Quercus phellos</i> L.
McCarty s.n.	6/13/92	Cyperaceae	<i>Rhynchospora capitellata</i> (Michx.) Vahl
McCarty s.n.	5/27/92	Cyperaceae	<i>Rhynchospora globularis</i> (Chapm.) Small
McCarty s.n.	8/24/92	Asteraceae	<i>Rudbeckia grandiflora</i> (Sweet) DC
McCarty s.n.	5/27/92	Asteraceae	<i>Rudbeckia hirta</i> L.
Hamilton #17	6/10/89	Polygonaceae	<i>Rumex hastatulus</i> Baldw.
Hamilton #26	6/10/89	Lamiaceae	<i>Salvia lyrata</i> L.
McCarty s.n.	5/27/92 & 7/30/92	Apiaceae	<i>Sanicula canadensis</i> L.
McCarty s.n.	5/27/92	Cyperaceae	<i>Scirpus koilolepus</i> (Steud.) Gleason
Blackmon #7	5/24/90	Lamiaceae	<i>Scutellaria laterifolia</i> L.
McCarty s.n.	7/30/92 & 9/12/92	Asteraceae	<i>Solidago ulmifolia</i> Small
McCarty s.n.	9/13/92	Asteraceae	<i>Solidago odora</i> Ait.
McCarty s.n.	9/12/92	Asteraceae	<i>Solidago rugosa</i> Ait.
McCarty s.n.	7/5/92	Poaceae	<i>Sorghum haspense</i> (L.) Pers.
Blackmon #31	5/24/90	Euphorbiaceae	<i>Stillergia sylvatica</i> Graden ex L.
McCarty s.n.	7/5/92	Convolvulaceae	<i>Stylisma pickeringii</i> (Torr.) A. Gray

McCarty s.n.	7/5/92 & 7/30/92	Lamiaceae	<i>Scutellaria parvula</i> Michx.
Hamilton #4	6/10/89	Fabaceae	<i>Tephrosia virginiana</i> (L.) Pers.
McCarty s.n.	7/30/92 & 9/12/92	Poaceae	<i>Tridens flavus</i> (L.) Hitchc.
Hamilton #35	6/10/89	Fabaceae	<i>Trifolium campestre</i> Schreb.
Hamilton #20	5/17/92	Campanulaceae	<i>Triodanis perfoliata</i> (L.) Nieuw.
& McCarty s.n.	5/8/92 & 5/27/92		
Blackmon #2	5/24/90	Ericaceae	<i>Vaccinium arboreum</i> Marsh.
McCarty s.n.	5/27/92	Valerianaceae	<i>Valerianella radiata</i> (L.) Dufr.
Hamilton #21	6/10/89	Verbenaceae	<i>Verbena simplex</i> Vent.
McCarty s.n.	7/5/92	Asteraceae	<i>Verbesina helianthoides</i> Michx.
McCarty s.n.	8/23/923	Asteraceae	<i>Vernonia baldwinii</i> Torr.

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\* s.n. - no collection number given

## APPENDIX J

### THE NATURE CONSERVANCY BOEHLER SEEPS AND SANDHILL PRESERVE ATOKA COUNTY, OKLAHOMA

Vascular plant collections made by L.C. Gatti Clark and  
The Nature Conservancy personnel arranged by family.

#### FERN ALLIES

Selaginellaceae - Spikemoss Family  
*Selaginella rupestris* (L.) Spring.                      Rock Spikemoss

#### FERNS

Azollaceae - Water Fern Family  
*Azolla caroliniana* Willd.                      Mosquito Fern

Dryopteridaceae - Wood Fern Family  
*Onoclea sensibilis* L.                      Sensitive Fern  
*Woodsia obtusa* (Spreng.) Torr.                      Blunt-lobed Cliff Fern

Ophioglossaceae - Adder's-tounge Family  
*Botrychium virginianum* (L.) Sw.                      Rattlesnake Fern

Osmundaceae - Royal Fern Family  
*Osmunda cinnamomea* L.                      Cinnamon Fern  
*Osmunda regalis* L., var. *spectabilis*  
(Willd.) A. Gray                      Royal Fern

## GYMNOSPERMS

Cupressaceae - Cypress Family  
*Juniperus virginiana* L.

Eastern Red Cedar

Pinaceae - Pine Family  
*Pinus echinata* Mill.

Shortleaf Pine

## ANGIOSPERMS

### Liliopsida - Monocots

Alismataceae - Water Plantain Family  
*Alisma subcordatum* Raf.  
*Echinodorus tenellus* (Mart.) Beuchenu  
*Sagittaria latifolia* Willd.

Water Plantain  
 Lanceleaf Burweed  
 Wapato, Duck Potato

Commelinaceae - Spiderwort Family  
*Commelina erecta* L.  
*Tradescantia ohimensis* Raf.

Erect Day Flower  
 Ohio Spiderwort

Cyperaceae - Sedge Family  
*Carex bicknellii* Britton  
*Carex blanda* Dewey  
*Carex cherokeensis* Schwein.  
*Carex complanata* Torr. & Hook.  
*Carex crinita* Lam.  
*Carex digitalis* Willd.  
*Carex frankii* Kunth.  
*Carex granularis* Muhl. ex Willd.  
*Carex gravida* Bailey  
*Carex hyalina* Boott.  
*Carex lupulina* Muhl.  
*Carex muhlenbergii* Schkuhr ex Willd.  
*Carex normalis* Mack.  
*Carex retroflexa* Muhl. ex Willd.  
*Carex squarrosa* L.  
*Carex swanii* (Fern.) Mack.  
*Carex vulpinoidea* Michx.  
*Cyperus uniflorus* Boeck.  
*Cyperus ovularis* (Michx.) Torr.  
*Cyperus strigosus* L.  
*Cyperus virens* Michx.

Bicknell's Sedge  
 Loose Flowered Sedge  
 Cherokee Sedge  
 Sedge  
 Fringed Sedge  
 Sedge  
 Frank's Sedge  
 Meadow Sedge  
 Heavy Sedge  
 Whitesheath Sedge  
 Hop Sedge  
 Muhlenberg's Sedge  
 Sedge  
 Reflexed Sedge  
 Sedge  
 Swan Sedge  
 Fox Sedge  
 One-flower Flatsedge  
 Globe Flatsedge  
 False Nutgrass  
 Green Flatsedge

<i>Dulichium arundinaceum</i> (L.) Britt.	Threeway Sedge
<i>Eleocharis compressa</i> Sulliv.	Flatstem Spikesedge
<i>Eleocharis acicularis</i> (L.) Roem. & Schult., var. <i>gracilescens</i> Svens.	Needle Spikesedge
<i>Eleocharis engelmannii</i> Steud.	Engleman's Spikesedge
<i>Eleocharis obtusa</i> (Willd.) Schultes, var. <i>lanceolata</i> (Fern.) Gilly	Blunt Spikesedge
<i>Eleocharis parvula</i> (R.&S.) Link, var. <i>anachaeta</i> (Torr.) Svens.	Dwarf Spikesedge
<i>Eleocharis tenuis</i> (Willd.) Schult., var. <i>verrucosa</i> (Svens.) Svens.	Slender Spikesedge
<i>Hemicarpha aristulata</i> (Cov.) Smyth	Hemicarpa
<i>Rhynchospora caduca</i> Ell.	Anglestem Beakrush
<i>Rhynchospora capitellata</i> (Michx.) Vahl.	False Bogrush
<i>Rhynchospora glomerata</i> (L.) Vahl	Clustered Beakrush
<i>Scirpus koilolepis</i> (Steud.) Gleason	Bulrush
<i>Scleria ciliata</i> Michx.	Fringed Nutrush
<i>Scleria triglomerata</i> Michx.	Whip Nutrush
Eriocaulaceae - Pipewort Family	
<i>Eriocaulon kornickianum</i> Van Heurch & Muell.-Arg.	Small Pipewort
Iridaceae - Iris Family	
<i>Iris virginica</i> L.	Southern Blue Flag
<i>Sisyrinchium angustifolium</i> Miller	Blue-eyed Grass
Juncaceae - Rush Family	
<i>Juncus acuminatus</i> Michx.	Jointed Rush
<i>Juncus coriaceus</i> Mack.	Leathery Rush
<i>Juncus effusus</i> L.	Bog Rush
<i>Juncus marginatus</i> Rostk.	Grassleaf Rush
<i>Juncus scirpoides</i> Lam.	Needlepod Rush
<i>Juncus tenuis</i> Willd.	Tender Rush
<i>Luzula bulbosa</i> (Wood) Rydb.	Bulb Woodrush
Lemnaceae - Duckweed Family	
<i>Spirodela polyrhiza</i> (L.) Schleiden	Duck Meat
Liliaceae - Lily Family	
<i>Allium canadensis</i> L.	Wild Onion
<i>Hypoxis hirsuta</i> (L.) Coville	Yellow Stargrass
Orchidaceae - Orchid Family	
<i>Platanthera flava</i> (L.) Linl.	Pale Green Orchid



## Poaceae - Grass Family

<i>Agrostis perennans</i> (Walt.) Tuckerm.	Autumn Bentgrass
<i>Andropogon gerardii</i> Vitman, var. <i>gerardii</i>	Big Bluestem
<i>Andropogon ternarius</i> Michx.	Splitbeard Bluestem
<i>Aria elegans</i> Willd.	Annual Siver Hairgrass
<i>Aristida desmantha</i> Trin. & Rupr.	Curly Threeawn
<i>Bouteloua hirsuta</i> Lag.	Harry Grama
<i>Bromus catharticus</i> Vahl.	Rescue Grass
<i>Bromus hordeaceus</i> L.	Soft Chess
<i>Bromus japonicus</i> Thunb. ex Murr.	Japanese Brome
<i>Cenchrus incertus</i> M.A. Curtis	Sandbur
<i>Chasmanthium latifolium</i> (Michx.) Yates	Inland Seaoats
<i>Chasmanthium laxum</i> (L.) Yates ssp. <i>sessiliflorum</i> (Poiret) L. Clark	Spike Inland Seaoats
<i>Danthonia spicata</i> (L.) Beauv. ex R.&S.	Poverty Oatgrass
<i>Elymus virginicus</i> L.	Virginia Wildrye
<i>Eragrostis capillaris</i> (L.) Nees	Lacegrass
<i>Eragrostis hirsuta</i> (Michx.) Nees	Bigtop Lovegrass
<i>Eragrostis secundiflora</i> Presl.	Red Lovegrass
<i>Eragrostis spectabilis</i> (Pursh) Steud.	Purple Lovegrass
<i>Erianthus giganteus</i> (Walt.) Muhl.	Giant Plumegrass
<i>Gymnopogon ambiguus</i> (Michx.) B.S.P.	Broadleaf Skeletongrass
<i>Leersia oryzoides</i> (L.) Sw.	Swartz Cutgrass
<i>Panicum anceps</i> Michx.	Beaked Panicum
<i>Panicum boscii</i> Poir.	Bosc Panicum
<i>Panicum depauperatum</i> Michx.	Slimleaf Panicum
<i>Panicum dichotomiflorum</i> Michx.	Fall Panicum
<i>Panicum dichotomum</i> L.	Forked Panicum
<i>Panicum hians</i> Ell.	Gaping Panicum
<i>Panicum lanuginosum</i> Ell.	Wooly Panicum
<i>Panicum linearifolium</i> Scribn.	Slimleaf Panicum
<i>Panicum oligosanthos</i> Schult.	Small Panicgrass
<i>Panicum ravenelii</i> Scribn.	Panicum
<i>Panicum sphaerocarpon</i> Ell.	Leafy Panicum
<i>Paspalum laeve</i> Michx.	Field Paspalum
<i>Paspalum setaceum</i> Michx.	Thin Paspalum
<i>Sacciolepis striata</i> (L.) Nash	American Cupscale
<i>Setaria geniculata</i> (Lam.) Beauv.	Knotroot Bristlegrass
<i>Sorghum halpense</i> (L.) Pers.	Johnsongrass
<i>Sphenopholis obtusata</i> (Michx.) Scribn.	Prairie Wedgescale
<i>Tridens flavus</i> (L.) Hitchc.	Purpletop
<i>Vulpia octoflora</i> (Walt.) Rydb.	Sixweeks Fescue
<i>Zizaniopsis miliacea</i> (Michx.) Doell. & Asch.	Southern Wildrice

Potamogetonaceae - Pondweed Family <i>Potamogeton pulcher</i> Tuckerm.	Spotted Pondweed
Smilacaceae - Greenbriar Family <i>Smilax rotundifolia</i> L. <i>Smilax bona-nox</i> L.	Common Greenbriar Greenbriar
Typhaceae - Cattail Family <i>Typha angustifolia</i> L.	Narrow-leaved Cattail

### Magnoliopsida - Dicots

Acanthaceae - Acanthus Family <i>Ruellia humilis</i> Nutt.	Fringed Leaf Ruellia
Amaranthaceae - Amaranth Family <i>Froelichia floridana</i> (Nutt.) Moq.	Snake Cotton
Anacardiaceae <i>Rhus aromatica</i> Ait. <i>Rhus copallina</i> L. <i>Toxicodendron radicans</i> (L.) O.Ktze	Lemon Sumac Winged Sumac Poision Ivy
Apiaceae - Carrot Family <i>Chaerophyllum tainturieri</i> Hook. <i>Daucus pusillus</i> Michx. <i>Eryngium prostratum</i> Nutt. ex DC <i>Hydrocotyle verticillata</i> Thunb. <i>Ptilimnium capillaceum</i> (Michx.) Raf.  <i>Sanicula canadensis</i> L. <i>Sanicula gregaria</i> Bickn. <i>Spermolepis divaricata</i> (Walt.) Britt. <i>Spermolepis echinata</i> (Nutt.) Heller <i>Spermolepis inermis</i> (Nutt.) Math. & Const. <i>Torilis arvensis</i> (Huds.) Link	Hairy Fruit Wild Chevil Southwestern Carrot Creeping Eryngo Whorled Pennywort Threadleaf Mockbishopweed Black Snakeroot Cluster Snakeroot Forked Scaleseed Bristly Scaleseed Spreading Scaleseed  Hedge Parsley
Apocynaceae - Dogbane Family <i>Apocynum cannabinum</i> L.	Indianhemp
Aquifoliaceae - Holly Family	

<i>Ilex decidua</i> Walt.	Deciduous Holly
Aristolochiaceae - Birthwort Family	
<i>Aristolochia reticulata</i> Nutt.	Netleaved Snakeroot
Asclepiadaceae - Milkweed Family	
<i>Asclepias tuberosa</i> L.	Butterfly Milkweed
<i>Asclepias verticillata</i> L.	Whorled Milkweed
<i>Asclepias viridis</i> Walt.	Green Milkweed
<i>Matelea biflora</i> (Raf.) Woodson	Twoflower Milkvine
Asteraceae - Sunflower Family	
<i>Achillea millefolium</i> L.	Yarrow
<i>Ambrosia artemesifolia</i> L.	Common Ragweed
<i>Ambrosia bidentata</i> Michx.	Lanceleaf Ragweed
<i>Ambrosia trifida</i> L.	Giant Ragweed
<i>Antennaria parlinii</i> Fern.	Plainleaf Pussytoes
<i>Aster patens</i> Ait.	Late Purple Aster
<i>Aster subulatus</i> Micx.	Salt Marsh Aster
<i>Astranthium integrifolium</i> (Michx.) Nutt.	Western Daisy
<i>Bidens aristosa</i> (Michx.) Britt.	Tickseed Sunflower
<i>Centaurea americana</i> Nutt.	American Basket Flower
<i>Chaetopappa asteroides</i> Nutt. ex DC	Least Daisy
<i>Chrysopsis pilosa</i> Nutt.	Softhair Golden Aster
<i>Chrysopsis villosa</i> (Pursh.) Nutt. ex DC	Roughhair Golden Aster
<i>Cirsium altissimum</i> (L.) Spreng.	Tall Thistle
<i>Cirsium horridulum</i> Michx.	Bull Thistle
<i>Conyza canadensis</i> (L.) Cronq.	Horseweed
<i>Coreopsis grandiflora</i> Hogg ex Sweet	Bigflowered Tickseed
<i>Echinacea pallida</i> Nutt.	Pale Coneflower
<i>Elephantopus carolinianus</i> Raeusch.	Elephant's Foot
<i>Erechtites hieracifolia</i> (L.) Raf. ex DC	Fireweed
<i>Erigeron strigosus</i> Muhl ex. Willd.	Daisy Fleabane
<i>Eupatorium coelestinum</i> L.	Blue Bonset
<i>Eupatorium perfoliatum</i> L.	Boneset
<i>Evax multicaulis</i> DC	Rabbit's Tobacco
<i>Evax prolifera</i> Nutt. ex DC	Rabbit's Tobacco
<i>Gaillardia aestivalis</i> (Walt.) Rock	Prairie Gaillardia
<i>Gnaphalium obtusifolium</i> L.	Sweet Everlasting
<i>Gnaphalium purpureum</i> L.	Purple Cudweed
<i>Haplopappus divaricatus</i> (Nutt.) Gray	Scrtch Daisy
<i>Helenium amarum</i> (Raf.) H. Rock	Sneezeweed
<i>Helianthus angustifolius</i> L.	Narrow-leaf Sunflower
<i>Helianthus hirsutus</i> Raf.	Hairy Sunflower
<i>Hieracium gronovii</i> L.	Hawkweed
<i>Hieracium longipilum</i> Torr.	Longbeard Hawkweed

<i>Hymenopappus scabiosaeus</i> L'Her.	Old Plainsman
<i>Krigia cespitosa</i> (Raf.) K.L. Chambers	Common Dwarf Dandelion
<i>Krigia dandelion</i> (L.) Nutt.	Potato Dandelion
<i>Krigia virginica</i> (L.) Willd.	Dwarf Dandelion
<i>Lactuca canadensis</i> L.	Wild Lettuce
<i>Lactuca sativa</i> L.	Prickly Lettuce
<i>Liatris aspera</i> Michx.	Tall Gayfeather
<i>Liatris elegans</i> (Walt.) Michx.	Beautiful Gayfeather
<i>Liatris squarrosa</i> (L.) Michx.	Gayfeather
<i>Mikania scandens</i> (L.) Willd.	Climbing Hempweed
<i>Pyrrhopappus carolinianus</i> (Walt.) DC	False Dandelion
<i>Pluchea camphorata</i> (L.) DC	Camphorweed
<i>Rudbeckia grandiflora</i> (Sweet) DC	Mexican Hat
<i>Rudbeckia hirta</i> L.	Blackeyed Susan
<i>Senecio obovatus</i> Muhl., var. <i>rotundus</i> Britton	Roundleaf Goundsel
<i>Solidago canadensis</i> L.	Common Prairie Goldenrod
<i>Solidago missouriensis</i> Nutt.	Missouri Goldenrod
<i>Solidago odora</i> Ait.	Fragrant Goldenrod
<i>Solidago rugosa</i> Ait.	Rough-leaved Goldenrod
<i>Solidago ulmifolia</i> Small	Elmleaf Goldenrod
<i>Verbesina helianthoides</i> Michx.	Yellow Crownbeard
<i>Vernonia baldwinii</i> Torr.	Western Ironweed
 Balsaminaceae - Touch-me-not Family	
<i>Impatiens capensis</i> Meerb.	Spotted Touch-me-not
 Berberidaceae - Barberry Family	
<i>Podophyllum peltatum</i> L.	May Apple
 Bignoniaceae - Bignonia Family	
<i>Campsis radicans</i> (L.) Seem.	Trumpet Creeper
 Boraginaceae - Borage Family	
<i>Lithospermum caroliniense</i> (Walt. ex Gmel.) MacM.	Plains Pucoon
<i>Myosotis verna</i> Nutt.	Early Scorpiongrass
 Brassicaceae - Mustard Family	
<i>Cardamine pennsylvanica</i> Muhl. ex Willd.	Bitter Cress
<i>Lepidium virginicum</i> L.	Poorman's Peppergrass
 Caesalpiniaceae - Caesalpiniaceae Family	
<i>Cassia fsciculata</i> Michx.	Partridge Pea

<i>Cassia nictitans</i> L.	Sensitive Pea
<i>Cercis canadensis</i> L.	Redbud
<i>Gleditsia triacanthos</i> L.	Honey Locust
Callitrichaceae - Water-Starwort Family	
<i>Callitriche heterophylla</i> Pursh	Water-Starwort
Campanulaceae - Bellflower Family	
<i>Triodanis perfoliata</i> (L.) Nieuw.	Clasping Venus Looking-glass
Caprifoliaceae - Honeysuckle Family	
<i>Lonicera japonica</i> Thunb.	Japanese Honeysuckle
<i>Symphoricarpos orbiculatus</i> Moench.	Buckbrush
<i>Viburnum rufidulum</i> Raf.	Rusty Blackhaw
Caryophyllaceae - Pink Family	
<i>Arenaria serpyllifolia</i> L.	Thyme-leaved Sandwort
<i>Paronychia drummondii</i> Torrey & Gray	Drummond's Nailwort
<i>Stellaria media</i> L.	Chickweed
Ceratophyllaceae - Hornwort Family	
<i>Ceratophyllum demersum</i> L.	Coontail
Cistaceae - Rockrose Family	
<i>Lechea villosa</i> Ell.	Pinweed
Clusiaceae - St. John's-wort Family	
<i>Hypericum drummondii</i> (Grev. & Hook.) Torr. & Gray	Nits-and-Lice
<i>Hypericum hypericoides</i> (L.) Crantz	St. Andrew's Cross
<i>Hypericum spathulatum</i> (Spach.) Steud.	St. John's-wort
Convolvulaceae - Morning Glory Family	
<i>Stylisma pickeringii</i> (Torr.) A. Gray	Stylisma
<i>Ipomoea pandurata</i> (L.) Mey.	Wild Potatovine
Cornaceae - Dogwood Family	
<i>Cornus florida</i> L.	Flowering Dogwood
Droseraceae - Sundew Family	
<i>Drosera brevifolia</i> Pursh	Sundew
Ericaceae - Heath Family	
<i>Vaccinium arboreum</i> Marsh.	Farkleberry

Euphorbiaceae - Spurge Family

*Acalypha rhomboidea* Raf.  
*Acalypha virginica* L.  
*Cnidioscolus texanus* (Muell.-Arg.) Small  
*Croton capitatus* Michx.  
*Croton glandulosus* L.  
*Crotonopsis elliptica* Willd.  
*Euphorbia serpens* H.B.K.  
*Stillingia sylvatica* L.

Rhombic Copperleaf  
Three Seeded Mercury  
Texas Bullnettle  
Woolly Croton  
Sand Croton  
Rush-foil  
Round-leaved Spurge  
Queen's Delight

Fabaceae - Pea Family

*Apios americana* Medic.  
*Astragalus distortus* Torrey & Gray  
*Baptisia bracteata* Ell.  
*Baptisia leucophaea* Nutt.  
*Clitoria mariana* L.  
*Desmodium paniculatum* (L.) DC,  
var. *paniculatum*  
*Desmodium sessilifolium* (Torr.)  
Torr. & Gray  
*Desmodium viridiflorum* (L.) DC  
*Galactia regularis* (L.) B.S.P.  
*Lespedeza stuevei* Nutt.  
*Petalostemon phleoides* Nutt.  
*Psoralea diditata* Nutt.  
*Psoralea psoraloides* (Walt.) Cory  
*Psoralea simplex* Nutt. ex Torr. & Gray  
*Psoralea subulata* Bush.  
*Rhynchosia latifolia* Nutt. ex Torr. & Gray  
*Strophostyles helvola* (L.) Ell.  
*Stylosanthes biflora* (L.) B.S.P.  
*Tephrosia virginiana* (L.) Pers.  
*Trifolium campestre* Schreb.  
*Vicia sativa* L.

Ground Nut  
Bentpod Milkvetch  
Plains Wild Indigo  
White Wild Indigo  
Butterfly Pea  
Tall Tickclover  
  
Sessile-leaved Tickclover  
  
Velvetleaf Tickclover  
Downey Milkpea  
Tall Lespedeza  
Longbract Prairie Clover  
Palm-leaved Scurf Pea  
Sampson's Snakeroot  
Singlestem Scurf Pea  
Sara Scurf Pea  
Broadleaf Snoutbean  
Wild Bean  
Pencil-flower  
Goat's Rue  
Low Hop Clover  
Common Vetch

Fagaceae - Beech Family

*Quercus falcata* Michx.  
*Quercus falcata* Michx., var. *triloba*  
(Michx.) Nutt.  
*Quercus incana* Bartr.  
*Quercus nigra* L.  
*Quercus phellos* L.  
*Quercus stellata* Wang.  
*Quercus velutina* Lam.

Southern Red Oak  
Southern Red Oak  
  
Bluejack Oak  
Water Oak  
Willow Oak  
Post Oak  
Black Oak

Fumariaceae - Fumitory Family <i>Corydalis micrantha</i> (Engelm.) Gray	Slender Fumewort
Geraniaceae - Geranium Family <i>Geranium carolinianum</i> L.	Carolina Cranesbill
Hydrophyllaceae - Waterleaf Family <i>Hydrolea ovata</i> Nutt. <i>Phacelia strictiflora</i> (Engelm. & Gray) Gray, var. <i>robbinsii</i> Constance	Hairy Hydrolea Prairie Blue Curls
Juglandaceae - Hickory Family <i>Carya myristiciformis</i> (Michx.) Nutt. <i>Carya texana</i> Buckl.	Nutmeg Hickory Black Hickory
Lamiaceae - Mint Family <i>Lycopus virginicus</i> L. <i>Monarda punctata</i> L. <i>Monarda russeliana</i> Nutt. ex Sims. <i>Prunella vulgaris</i> L. <i>Pycnanthemum albescens</i> Torr. & Gray <i>Pycnanthemum tenuifolium</i> Schrad.  <i>Salvia lyrata</i> L. <i>Scutellaria elliptica</i> Muhl. <i>Scutellaria laterifolia</i> L. <i>Scutellaria parvula</i> Michx., var. <i>leonardii</i> (Epl.) Fern	Virginia Bugleweed Horsemint Red Spotted Horsemint Heal-all Whiteleaf Mountainmint Narrowleaf Mountainmint Lyreleaf Sage Hairy Skullcap Sideflowering Skullcap Skullcap
Lauraceae- Laurel Family <i>Sassafras albidum</i> (Nutt.) Nees, var. <i>molle</i> (Raf.) Fern.	Sassafras
Lentibulariaceae - Bladderwort Family <i>Utricularia biflora</i> Lam.	Twoflower Bladderwort
Loganiaceae - Logania Family <i>Polypremum procumbens</i> L.	Juniperleaf
Lythraceae - Loosestrife Family <i>Rotala ramosior</i> (L.) Koehne	Toothcup
Melastomaceae - Meadow Beauty Family <i>Rhexia mariana</i> L.	Meadow Beauty

Menyanthaceae - Buckbean Family <i>Nymphoides peltata</i> (Gmelin) Kuntze	Yellow Floating Heart
Mimosaceae - Mimosa Family <i>Schrankia nuttallii</i> (DC ex Britt. & Rose) Standl. <i>Schrankia ucinata</i> Willd.	Sensitive Briar Catclaw Briar
Monotropaceae - Indian Pipe Family <i>Monotropa hypopithys</i> L.	Pinesap
Nelumbonaceae - Lotus Family <i>Brasenia schreberi</i> J.F. Gmel. <i>Nuphar lutea</i> (L.) J.E. Smith <i>Nymphaea odorata</i> Ait.	Water-Shield Yellow Pond Lily American Water Lily
Nyssaceae - Tupelo Family <i>Nyssa sylvatica</i> Marsh.	Black Gum
Onagraceae - Evening Primrose Family <i>Ludwigia alternifolia</i> L. <i>Oenothera laciniata</i> Hill	Bushy Seedbox Cutleaf Evening Primrose
Oxalidaceae - Wood Sorrel Family <i>Oxalis violacea</i> L., var. <i>violacea</i> <i>Oxalis stricta</i> L.	Violet Wood Sorrel Yellow Wood Sorrel
Plantaginaceae - Plantain Family <i>Plantago lanceolata</i> L. <i>Plantago patagonica</i> Jacq. <i>Plantago virginica</i> L. <i>Plantago wrightiana</i> Dcme.	Buckhorn Plantain Wooly Plantain Paleseed Plantain Wright's Plantain
Polemoniaceae - Polemonium Family <i>Phlox glaberrima</i> L. <i>Phlox pilosa</i> L.	Smooth Phlox Prairie Phlox
Polygalaceae - Milkwort Family <i>Polygala sanguinea</i> L.	Blood Polygala
Polygonaceae - Buckwheat Family <i>Eriogonum longifolium</i> Nutt. <i>Eriogonum multiflorum</i> Benth. <i>Polygonella americana</i> (Fisch. &	Longleaf Eriogonum Heartsepal Wild Buckwheat Southern Jointweed



Mey.) Small	
<i>Polygonum hydropiperoides</i> Michx.	Mild Water Pepper
<i>Polygonum persicaria</i> L.	Lady's Thumb
<i>Polygonum sagittatum</i> L.	Arrowvine
<i>Rumex hastatulus</i> Baldw.	Heartwing Sorrel
Primulaceae - Primulaceae Family	
<i>Hottonia inflata</i> Ell.	American Featherfoil
<i>Lysimachia lanceolata</i> Walt.	Lanceleaf Loosestrife
Ranunculaceae - Buttercup Family	
<i>Delphinium carolinianum</i> Walt.	Prairie Larkspur
<i>Ranunculus laxicaulis</i> (Torr. & Gray) Darby	Spearwort
Rhamnaceae - Buckthorn Family	
<i>Berchemia scandens</i> (Hill.) K. Koch	Rattan Vine
<i>Ceanothus americanus</i> L.	New Jersey Tea
<i>Rhamnus caroliniana</i> Walt.	Buckthorn
Rosaceae - Rose Family	
<i>Crataegus spathulata</i> Michx.	Littlehip Hawthorn
<i>Potentilla simplex</i> Michx.	Old-field Cinquefoil
<i>Prunus serotina</i> Ehrh.	Black Cherry
<i>Rubus occidentalis</i> L.	Blackberry
<i>Rubus ostryifolius</i> Rydb.	Highbush Blackberry
Rubiaceae - Madder Family	
<i>Cephalanthus occidentalis</i> L.	Buttonbush
<i>Diodia teres</i> Walt.	Rough Buttonweed
<i>Galium arkansanum</i> A. Gray	Arkansas Bedstraw
<i>Galium circaezans</i> Michx.	Woods Bedstraw
<i>Galium obtusum</i> Bigelow	Bluntleaf Bedstraw
<i>Galium pilosum</i> Ait.	Hairy Bedstraw
<i>Hedyotis australis</i> Lewis & Moore	Bluet
Sapotaceae - Sapodilla Family	
<i>Bumelia lanuginosa</i> (Michx.) Pers.	Chittamwood
Scrophulariaceae - Figwort Family	
<i>Agalinis tenuifolia</i> (Vahl.) Raf.	Slenderleaf Agalinus
<i>Castilleja coccinea</i> (L.) Spreng.	Indian Paintbrush
<i>Castilleja indivisa</i> Engelm.	Indian Paintbrush
<i>Collinsia violacea</i> Nutt.	Violet Collinsia
<i>Gratiola virginiana</i> L.	Virginia Hedgehyssop
<i>Linaria canadensis</i> (L.) Dumont	Blue Toadflax
<i>Lindernia dubia</i> (L.) Pennell	Yellowseed False

<i>Pedicularis canadensis</i> L., var. <i>dobsii</i> Fern.	Pimpernell
<i>Penstemon laxiflorus</i> Pennell	Common Lousewort
<i>Penstemon murrayanus</i> Hooker	Loose Flower Penstemon
	Cupleaf Penstemon
Solanaceae - Nightshade Family	
<i>Physalis heterophylla</i> Nees.	Clammy Ground Cherry
<i>Solanum carolinense</i> L.	Carolina Horsenettle
Ulmaceae - Elm Family	
<i>Celtis tenuifolia</i> Nutt.	Dwarf Hackberry
Urticaceae - Nettle Family	
<i>Boehmeria cylindrica</i> (L.) Sw.	False Nettle
Valerianaceae - Valerain Family	
<i>Valerianella radiata</i> (L.) Dufr.	Common Beaked Cornsalad
Verbenaceae - Vervain Family	
<i>Callicarpa americana</i> L.	American Beautyberry
<i>Phryma leptostachya</i> L.	Lopseed
<i>Verbena simplex</i> Vent.	Narrow-leaved Verbena
Violaceae - Violet Family	
<i>Viola villosa</i> Walt.	Wooly Violet
Vitaceae - Grape Family	
<i>Ampelopsis arborea</i> (L.) Koehne	Peppervine
<i>Parthenocissus quinquefolia</i> (L.) Planch.	Virginia Creeper
<i>Vitis aestivalis</i> Michx.	Pigeon Grape
<i>Vitis rotundifolia</i> Michx.	Muscadine

## VITA<sup>2</sup>

Linda Carol Gatti Clark

Candidate for the Degree of

Doctor of Philosophy

Thesis: FLORISTIC AND BIOSYSTEMATIC INVESTIGATIONS  
IN PLANT TAXONOMY

Major Field: Botany

### Biographical:

Personal Data: Born in Memphis, Tennessee, on 25 June, 1966, the daughter of Joseph F. and Patricia A. Gatti.

Education: Graduated from Lake Hamilton High School, Percy, Arkansas in May 1984; received Bachelor of Science in Biology with a minor in Interdisciplinary Studies from the University of Central Arkansas, Conway, Arkansas in May, 1989; completed the requirements for the Doctor of Philosophy degree with a major in Botany at Oklahoma State University in May, 1997.

Professional Experience: Graduate Teaching/Research Assistant in the Department of Botany, Oklahoma State University 1990-1996; Served as instructor and teaching assistant for summer science academies, Oklahoma Principal Science Scholars (OPSS) and National Aeronautics Space Administration - American Indian Science, Technology, and Education Consortium (NASA-AISTEC), Summers 1992-1996; Vegetation Sampling for Sutton Avian Research Center, Bartlesville, Oklahoma, Summers 1992, 1994 and for The Nature Conservancy, Tallgrass Prairie Preserve, Pawhuska, Oklahoma, Summer 1992.

Professional Memberships: Arkansas Native Plant Society, Oklahoma Native Plant Society, American Society of Plant Taxonomists, Botanical Society of America, American Association of Women in Science.